

**A STUDY OF
STUDENTS COMMON ERRORS WITH SPECIAL REFERENCE TO THE
EFFICACY OF THE OBJECTIVE BASED EXAMINATION SYSTEM
IN
GENERAL SCIENCE, SECONDARY EXAMINATION, 1972**

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AJMER
1974**

ACKNOWLEDGEMENT

I wish to express my appreciation to Messers S.L.Mathur, Snehlata Sharma and T.C.Jain of the study group in performing the various stages of data collection and scrutinising the answerbooks.

I would like to express my appreciation to P.L.Pareek academic officer, Board of Secondary Education, Rajasthan, Ajmer and the Project Director, for his consistent interest, help and suggestion; during the course of the study.

I am grateful to Shri K.L.Bordia, Chairman, Board of Secondary Education, Rajasthan, Ajmer for his valuable encouragement during the course of the study.

Thanks are also due to B.B.Gupta, ex-secretary and N.S.Tanwar Secretary Board of Secondary Education, Rajasthan, Ajmer for their interest in the project.

I am thankful to G.S.Mathur, M.L.Jain and J.D.Mathur of the Board of Secondary Education, Rajasthan Ajmer for their help during this research.

I am thankful to Prof. S.Loknathan, Head, Department of Physics, University of Rajasthan for allowing me to do this study.

Thanks are due to A.K.Chawla in performing the various stages of the typing of the manuscript.

The support and interest of the NCERT, New Delhi and Board of Secondary Education, Rajasthan, Ajmer is greatly appreciated.

११.१२.७४
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25th Dec., 1974.

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C H A P T E R - I

INTRODUCTION

The Board of Secondary Education, Rajasthan has already introduced a number of changes in the examinations conducted by it with a view to improving their reliability, validity, objectivity and pedagogical values. This has been largely achieved by improving the quality of questions, question-papers, scoring procedures and a host of other things related to examinations. Overall options have been completely replaced by internal options in a few questions. The content coverage has been sufficiently increased. Objectivity has been built in by introducing objective type questions and by providing a detailed marking scheme for short and essay type questions (to ensure uniformity in marking by different examiners).^{1,2} This new scheme has now been in force for a number of years and it is high time to study how ^afor it is achieving the purpose for which it was introduced. With this end in view the Academic Section of the Board of Secondary Education, Rajasthan decided to get the question papers and students answer books in a few selected school subjects examined by a small group of teachers. This study is concerned with the assessment of the question paper (Appendix 1) and the answer-books of candidates appearing in General Science for the Secondary Examination, 1972.

1.1 THE PROBLEM :-

How far have the newly framed objectives of teaching General Science been actually tested in question paper of General Science for Secondary Examination, 1972 and how far have

these objectives actually been achieved by the candidates in the main area investigated in this study. What were the significant errors made by students ? What were the areas in which instruction was especially found to be poor and to what extent did each question discriminate between the better and poorer examinees? These specific issues constitute the scope of the study. The study in the light of the findings of the above questions, also aims at exploring the ways and means for the qualitative improvement of question papers and remedial action for dealing with the errors of students.

1.2 DELIMITATION :-

1. Only the question paper in general Science set for the Secondary Examination, 1972 has been analysed.
2. Only two hundred twenty four answer-books of the students selected on the basis of stratified sampling technique have been examined. Care has, however, been taken to have the same percentage of 1st, 2nd and 3rd Class students and of those who failed as in the total examination.

Thus the answer books scrutinized were as follows:-

No. of the Answerbooks of 1st Class candidates	42
No. of the Answerbooks of 2nd Class candidates	62
No. of the Answerbooks of 3rd Class candidates	75
No. of the Answerbooks who failed	45
Total	<u>224</u>

1.3 OPERATIONAL OBJECTIVES OF THE STUDY :-

- i. To find out how far the objectives of teaching General Science were actually covered in the question paper

of General Science for the Secondary Examination, 1972.

- ii. To find out how far the newly framed objectives were actually achieved in the sample of answerbooks selected for the purpose. The sample, it is hoped, is a fair representative of the total population.
- iii. To what extent did each question discriminate between the better and poorer examinees ?
- iv. To find out the areas in which instruction was particularly good or particularly poor and needs improvement.
- v. To specify the possible kinds of errors of the candidates whose answerbooks were actually scrutinized in respect of each question and
- vi. To make a few suggestions for the improvement of class room teaching.

PROCEDURE ADOPTED :-

The present study is an integral part of a comprehensive Project undertaken under the guidance of Shri P.L. Pareek, Academic Officer, Board of Secondary Education, Rajasthan, Ajmer who has acted as the overall director of the Project. The Project covers a wide range of subjects like General English at the Secondary and Higher Secondary stage, Elementary Mathematics, General Science, Physics, Chemistry and Mathematics for the Secondary Examination. It is also contemplated to take up the answerbooks of other major subjects for the study so that gradually the assessment of all the question papers and the errors committed by candidates therein are studied with a view to improving the quality of question papers and suggesting a remedial plan of action for dealing with students errors.

With a view to implementing the project the study teams have been constituted for each subject separately. The coordination of the different teams has been done by Shri P.L.Pareek, Director of the Project. The present study has been attempted by the team consisting of :

1. Dr. M.L.Sisodia,Leader of the Project
2. Shri S.L.Mathur
3. Shrimati Snehlata Sharma
4. Dr. T.C.Jain

The study team prepared a research design and evolved:-

- i) an analysis card for data collection of Multiple choice questions (Appendix 3);
- ii) a consolidated analysis card for multiple choice questions (Appendix 3);
- iii) a proforma for analysis of Essay and short answer questions (Appendix 4);
- iv) The study group analysed the question paper of General Science, 1972 in terms of cognitive objectives and developed a consolidated analysis card for distribution of percentage of marks in regard to objectives (Appendix 5).
- v) The team worked out the processes involved in answering each question and developed a card noting the responses of candidates in terms of processes involved and possible errors by analysing the answer script of each candidate (Appendix 3).

Each member of the team analysed 56 answer books for the various categories of students for collection of data.

The team later met many times to classify and consolidate the data. The report was actually drafted by the leader and edited by the Director of the Project.

PROPOSED OUTLINE :-

In addition to this introductory chapter, the remaining chapters are as follows:-

CHAPTER-II Contains an analysis of question paper in General Science for Secondary Examination, 1972 and present an overall achievement of examinees in regard to objectives.

CHAPTER-III Attempts item analysis. This includes the results of the scrutiny of answer books in terms of processes involved in answering the questions and the specific errors committed by the students under each process or step.

CHAPTER-IV Summarises the findings of the present investigations. Suggestions are made for the improvement of Class- room teaching in an effective manner and its evaluation technique.

C H A P T E R I I

Analysis of question paper of General Science; 1972 and achievement of examinees

2.1 Introduction :-

It is difficult to say what exactly constitutes an ideal question paper (test) that would measure students achievement in General Science in regard to instructional objectives; namely content and cognitive (intellectual activity involved) objectives objectively and effectively. However, subject teaching experts agree that a carefully balanced pattern of essay type, short answer type and objective type questions would prove fairly effective in assessing students overall performance in each subject. It is also agreed that each form of question should be able to assess one or two or more intellectual activities (knowledge, understanding, application and skill) of the students. We will first examine the General Science question paper in this light and then we will examine the achievements of examinees in the various area of study and cognitive objectives.

2.2 The pattern of the question paper :-

There is one question paper scheme in General Science for the Secondary School Examination carrying 50 marks. The analysis of the question paper (Appendix 1) reveals that all the questions can be grouped in the following four categories.

- | | | | |
|------|------------------------|---|-----------|
| (I) | Objective Type | } | Section A |
| (II) | Very short answer Type | | |

(III)	Short answer Type	}	Section B
(IV)	Essay Type		

The first two types of questions are grouped in Section A carrying 15 marks and the remaining two types in Section B carrying 35 marks. Section A is to be answered and returned to the Invigilators at the end of the first half an hour, and Section B to be answered in the remaining two hours. This is done to obviate copying, because Section A has objective type questions, the answers to which can be easily copied or communicated through gestures. There is no other psychological or educational reason behind this division of the paper into two sections. There seems to be an unfair distribution of time between two sections of paper. Section A which carries 15 marks is allotted only half an hour, while section B, which carries 35 marks, is allotted two hours. But this may not be very serious as essay type and short answer type questions require more time to answer.

2.3 Weightage to Form of questions:-

The following Table (2.1) gives an idea of the weightages given to the form of questions, marks allotted to each category of questions in General Science question paper 1972 being mentioned in the table.

Table 2.1

WEIGHTAGE TO FORM OF QUESTIONS

Form of questions	No. of questions	Marks	Percentage of Marks	Time allotted
SECTION A				
(I) Objective Type (Multiple choice Type)	20	10	20%	} $\frac{1}{2}$ hour
(II) Very short answers type	5	5	10%	
Section B				
(III) Essay Type	3	15	30%	} 2 hours
(IV) Short answer Type	10	20	40%	

It is suggested that the present weightage to the forms of questions be continued. Objective type questions always need not be of multiple choice type.

2.4 Weightage to objectives:-

Prof. Bloom³ developed a six category classification of the cognitive objectives on the basis of the intellectual activity involved in the students. But in practice it is⁴ advantageous to use four category classification system i.e. (I) knowledge (II) understanding (III) Application and (IV) Skill for General Science. Therefore, it is quite necessary that questions in a question paper should test all the four cognitive objectives. In view of this the question paper of 1972 is analysed by the study group.

Table (2.2) shows the weightage given to each category of objectives in the question paper.

Table 2.2

WEIGHTAGE TO OBJECTIVES IN TERMS OF MARKS ALLOTTED

Distribution of marks

S. No.	Category of objectives	Section A 25 Questions			Section B 13 questions		Grand total of Sec. A & B	Percentage & Total marks
		Multiple choice type	Very short answer type	Total	Essay type			
1.	KNOWLEDGE	6	2	8(53.3%)	8(23 %)		16	32%
2.	UNDERSTANDING	4	2	6(42 %)	13(56.5%)		19	38%
3.	APPLICATION	-	1	1(6.7%)	4 (11.5%)		5	10%
4.	SKILL	-	-	-	10(28.4%)		10	20%
Total		10	5	15(100%)	35(100%)		50	100%

It is, however, suggested that the weightage given to the skill objective be decreased and more weightage be given to understanding objective. A practical distribution of marks to various objectives, looking to the Indian conditions, would be as follows:

1. Knowledge 32% of the total marks
2. Understanding 48% of the total marks
3. Application 10% of the total marks
4. Skill 10% of the total marks

This will enable the student to interpret his environment and to fit himself into the modern developing Society.

2.5 Weightage to content:-

An analysis of the General Science question paper 1972, shows that most of the topics in the syllabus have been represented in the paper. Overall options have been eliminated completely but internal option with in the essay type question has been allowed. The alternate question is also from the same unit of study. The weightage given in terms of marks and forms of questions to the various units of the syllabus is given in Table (2.3).

Table 2.3

WEIGHTAGE TO VARIOUS UNITS OF STUDY IN TERMS OF MARKS AND FORM OF QUESTION

S. No.	UNIT OF STUDY	No of Questions				TOTAL MARKS and questions (Marks are written in bracket)
		SECTION A	SECTION B			
		Multiple choice type	Very short Answer type	Essay Type	Short Ans. type	
1.	Matter & Energy	3(1½)	1(1)	1(5)	-	5(7½)
2.	The earth and its Mystries	2(1)	2(2)	-	1(2)	5(5)
3.	Universe	2(1)	-	-	2(4)	4(5)
4.	Meteorology	-	-	1(5)	-	1(5)
5.	Natural Resources	2(1)	-	-	1(2)	3(3)
6.	Plants and animals	4(2)	1(1)	-	2(4)	7(7)
7.	Nutrition and Health	5(2½)	1(1)	-	1(2)	7(5½)
8.	Preparation of useful matter	2(1)	-	-	3(6)	5(7)
9.	Transport and Communication	-	-	1(5)	-	1(5)
	Total	20(10)	5(5)	2(10)	10(20)	38(50)

The above table denotes that all the units of the study have been given nearly equal weightage in terms of marks i.e. 10%^{of} total marks. The three units namely (1) matter and energy (2) Plants and Animals and (3) Preparation of useful material have been given 14% weightage and looking to the importance of these units in the study of General Science the weightage seems to be proportionate.

Table (2.4) shows the weightage in terms of marks allotted to the objectives in the various units of study.

Table 2.4

DISTRIBUTION OF MARKS TO OBJECTIVES IN VARIOUS UNITS OF STUDY

S. No.	UNIT OF STUDY	MARKS IN COGNITIVE OBJECTIVES				Total marks in each Unit of study.
		Knowledge	Under- standing	Applica- tion	Skill	
1.	Matter & Energy	1	4½	-	2	7½
2.	The Earth & its Mysteries	1	3	1	-	5
3.	Universe	3	-	-	2	5
4.	Meteorology	-	3	-	2	5
5.	Natural Resources	½	½	2	-	3
6.	Plants and Animals	3	2	-	2	7
7.	Nutrition and Health	2½	1	2	-	5½
8.	Preparation of useful material	5	2	-	-	7
9.	Transport and Communi- cation.	-	3	-	2	5

Grand Total		16(32%)	19(38%)	5(10%)	10(20%)	50(100%)

We note from the table that marks are evenly distributed over various units of study in terms of objectives.

2.6 Arrangement of questions:-

The analysis shows that items of similar content are not grouped together in one section of the question paper as shown in the following Table (2.5)

Table 2.5

Unit of study	Question No.in SECTION-A	Question No.in SECTION B
1. Matter and Energy	12,14,17,25	3 or 3
2. The Earth & its Mystries	2,5,21,22	5
3. Universe	1,4	4,12
4. Natural resources	15,16	11
5. Meteorology	-	1 or 1
6. Plants and Animals	3,6,8,9,23	6,13
7. Nutrition & Health	7,10,11,13,19,24	7
8. Preparation of useful material	18,20	8,9,10
9. Transport and Communication	-	2 or 2

The paper thus appears to the examinee fragmented and the cannot attack it in an integrated fashion, this may affect the over all achievement of the students. It is suggested that items of similar content be grouped together. This will permit the students to attempt all items dealing with a given content before moving to the next. In this way the paper may appear to the examinee less fragmented and he may attack it in a more

integrated fashion. Paper setters be requested to further arrange items from a particular content according to their difficulty level. It is usually good to progress from the easy to more difficult items.

2.7 Effectiveness of construction:-

(1) The essay and short answers type questions require the examinee to read the question, formulate his response and write the response in a sequence. Most of the essay and short answer type questions of the paper seem to be constructed well. We will discuss this point in greater details in Chapter III. (2) Effectiveness in the construction of objective type questions will be discussed in Chapter III where item analysis is attempted.

2.8 Scoring key and Marking Scheme for the Examiners:-

Scoring key for Section A:- Answers to questions No. 1 and 7 were wrongly given and this has affected the marking of the answer books.

Marking scheme for Very Short Answers questions in Section A:-

The marking scheme was not proper, it should have been more detailed in terms of processes involved in answering the questions. A detailed discussion in regard to processes involved is further attempted in Chapter III.

Marking Scheme for Section B:- This is again more sketchy and needs to be more detailed. This point will be again discussed in Chapter III.

Note :- Question paper of 1972, scoring key and Marking Scheme is appended (Appendix 1 and 2).

2.9 Concluding remarks:-

From the various points of view as discussed above, we can conclude that the design of the question paper of General Science 1972 was not satisfactory in regard to coverage of objectives. A more detailed marking scheme, however, is needed to ensure uniformity in marking by different examiners. Weightage to skill should be decreased by 10% and understanding to be increased by 47%.

We will now present the achievement of students in terms of objectives and units of study.

2.10 The Pattern of Scoring:-

Altogether two hundred answerbooks were scrutinized by the study group of four members. The sample contained the same percentages of first division, second division, third division and unsuccessful candidates as those in the Boards' examination. The distribution of the candidates in the sample among the four categories was as follows:

First division	:	42 (18.7%)
Second division	:	62 (28%)
Third division	:	75 (33.3%)
Candidates who failed	:	45 (20%)
Total	:	224 (100%)

In this section we propose to examine how students actually fared in two sections of the question paper under each objective and each unit of study.

2.11 The pattern of Scoring in Section A and B:-

Graph 2.1 shows the number of students scoring above 60% , above 45% but less than 61%, above 30% but less than 46%, and above 6% but less than 31% marks in Section A, Section B and in the whole paper.

We note from the graph that the achievement of students in terms of score at the examination is far better in Section A as compared to Section B. In Section A 82 students out of 224 students scored above 60% marks as compared to 22 students out of 224 students in Section B. This has affected the overall performance of candidates (We find that only 32 out of 224 students could get above 60% marks in the whole question paper).

2.12 Relationship between Scores and Weightage to objectives:-

Now let us take up the relationship between the scores and weightage given to the objectives in Section A and Section B. From Table 2.2 we notice that in Section A weightage to knowledge was 53.3% of the total marks allotted to Section A as compared to 23% of the total marks allotted to Section B. Weightage to understanding and Application in Section A was 46.7% of the marks allotted to Section A and in Section B 68% of the total marks allotted to Section B. 28.4% weightage is given to skill in Section B as compared to Zero percent weightage in Section A. These variations of weightages to objectives in Section A and Section B may be the reason of better achievement of students in Section A as compared to Section B, because of the fact that cognitive objectives like understanding, application and skill need higher order of intellectual ability on the part of students thereby making Section B difficult as compared to



ABOVE 60% MARKS



ABOVE 50% BUT LESS THAN 60% MARKS



ABOVE 40% BUT LESS THAN 50% MARKS



ABOVE 30% BUT LESS THAN 40% MARKS

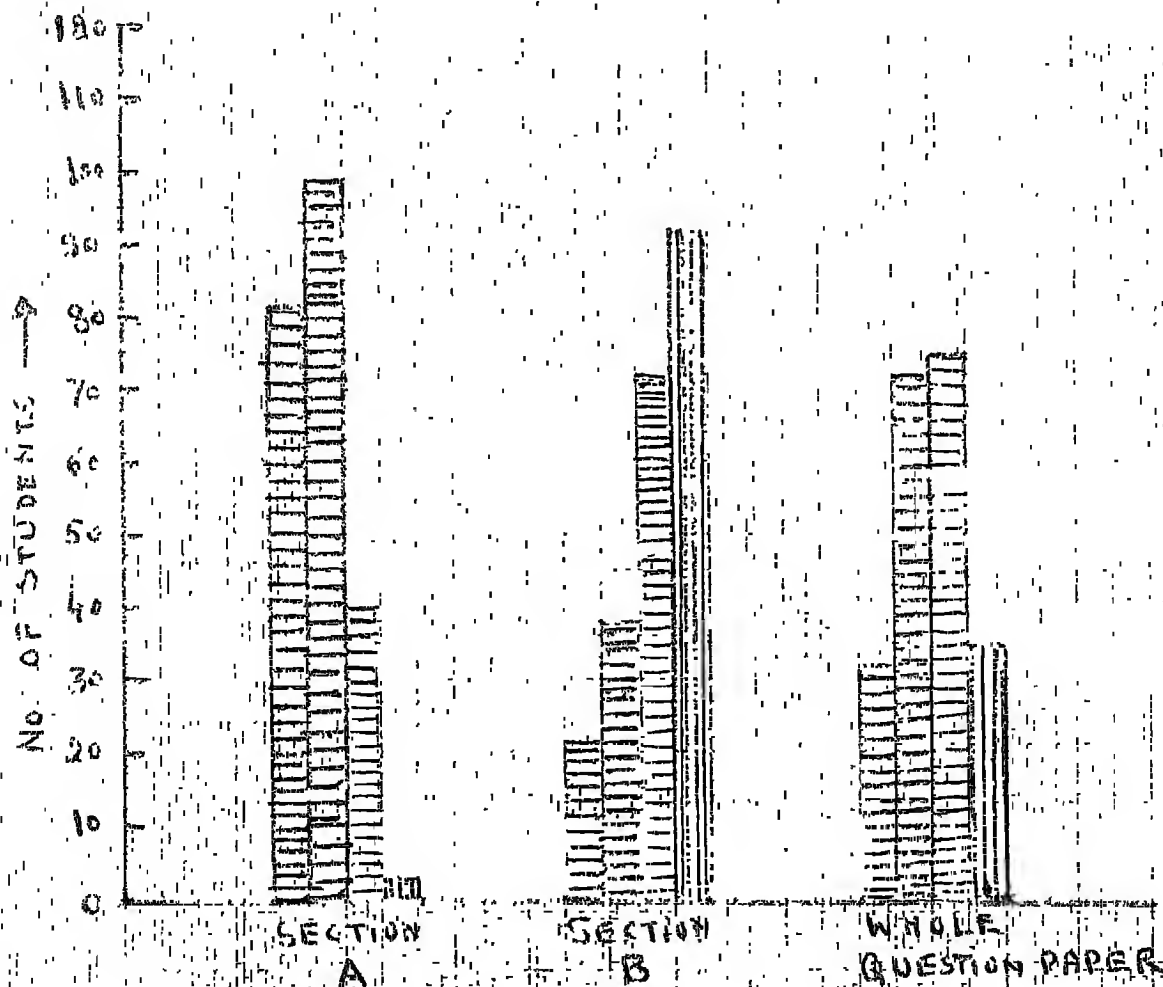


Fig. 21 SCORING PATTERN IN SECTION A
SECTION B AND WHOLE QUESTION PAPER

Section A. Hence we can conclude that there is a close relationship between the weightages given to the objectives and the performance of the candidates. Thus it is suggested that equal weightages to objectives be given in Section A and Section B, so that the achievements of the students may be nearly the same in both the sections. We suggest the following break up of marks for various objectives in Section A and in Section B.

Table 2.6
SUGGESTED WEIGHTAGES TO OBJECTIVES IN SECTION
A AND B

Categories of objectives	Marks allotted to whole Question paper	Marks allotted to Section B	Marks allotted to Section A
KNOWLEDGE	16(32% of the total marks)	11 (32%)	5 (32%)
UNDERSTANDING	24(48% of the total marks)	17 (48%)	7 (48%)
APPLICATION	5 (10% of the total marks)	3.5(10%)	1.5(10%)
SKILL	5 (10% of the total marks)	3.5(10%)	1.5(10%)
Total	50(100%)	35(100%)	15(100%)

2.13 Response of the students in Multiple choice Type Questions:-

Achievement in instructional objectives:-

In the question paper there were twenty multiple choice type questions; out of which twelve questions were asked to test knowledge and eight questions were asked to test understanding

of the students in the various units of study. Tables (27) and(2.8), respectively, indicate the performance of the various categories of our students in the areas of knowledge and understanding.

Table 2.7

Achievement of the area of knowledge

S. No.	Categories of students in whole papers	Total No.	No of students who answered correctly to knowledge questions												
			Q.No.												
			1	3	4	6	7	10	11	12	14	15	18	19	
1.	FIRST DIVISION	42	40	41	32	29	22	40	34	42	36	21	35	31	
2.	SECOND -do-	62	55	60	31	37	33	40	45	59	46	22	42	41	
3.	THIRD -do-	75	62	70	35	45	39	62	37	54	53	18	31	58	
4.	CANDIDATES WHO FAILED	45	30	39	19	19	23	28	24	33	26	8	12	14	

Table 2.7 indicates that more than 60% students who passed in the whole paper have answered 10 out of 12 questions multiple choice type testing knowledge objective correctly. Hence we can say that the achievement of students in this area of the objective is good.

Table 2.8

ACHIEVEMENT IN UNDERSTANDING

S. No.	Categories of students in the total students	Total No. of students in each category	No of students who answered correctly to understanding questions							
			Q.No.							
			2	5	8	9	13	16	17	20
1.	FIRST DIVISION	42	31	28	18	30	36	40	40	16
2.	SECOND "	62	32	22	27	45	31	53	59	9
3.	THIRD "	75	23	26	26	27	26	54	55	18
4.	CANDIDATE WHO FAILED	45	8	18	17	15	12	20	25	7

We find from the above Table that 5 out of 8 Multiple choice type questions testing the objective of understanding have been wrongly answered by more than 50% students who passed in the whole paper. Thus a large number of students fail to achieve this objective i.e. understanding.

2.14 Achievement in various units of study:-

Table (2.9) shows the performance of the various categories of students in the various units of study.

Table 2.9

ACHIEVEMENT IN VARIOUS UNITS OF STUDY

TS Category Students	Total No. of students in each category	Number of students answering correctly															
		Unit 1 Q.No.	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
		(12 14 17)	(2 5)	(1 4)	(15 16)	(3 6 8 9)	(7 10 11 13 19)	(18 20)									
Div.	42	42 36 40 31 28 40 32	21 40 41 29 18 30 22 40 34 36 31 35 16														
"	62	59 46 59 32 22 55 31	22 53 60 37 27 45 33 40 45 31 43 42 9														
I "	75	54 53 55 23 26 62 35	18 54 70 45 26 47 39 62 37 26 54 31 18														
II	45	33 26 25 8 13 30 19	8 20 39 19 17 15 23 28 24 24 12 19 27														

UNIT : 1 Matter and Energy

From this unit two questions were asked to test the knowledge of the students, one question was asked to test understanding in Multiple choice questions. We note from the table that more than 75% students, who passed in the whole paper have answered correctly these three questions. As such we can conclude that the achievement of students in this area of study, is quite good.

Unit : 2 The Earth and its Mysteries:-

From this Unit two questions were asked to test understanding. We notice from the above that around 50% students, who passed in the whole paper, have answered correctly these two questions. Therefore, we may say that students achievement in this area of study seems to be poor.

Unit : 3 Universe :-

It is noted that more than 60% students, who passed in the whole paper, have answered the questions from this unit correctly. These questions were asked to test knowledge. Thus it may be concluded that the achievement of students in this part is good.

Unit : 5 Natural Resources:-

There were two multiple choice type questions, one testing knowledge and the other testing understanding. We find from the table that question (Q.No.15) testing knowledge has been wrongly answered by a large majority of students who have passed in the whole paper. On the other hand, question (Q.No.16) testing understanding has been correctly answered by a large majority of the students who have passed in the whole paper. Thus it is difficult to say whether the achievement of the students in this unit of study has been good or bad.

Unit:6 : Plants and Animals:-

Four questions were asked from this Unit. Three questions were answered correctly by more than 60% students who have passed in the whole paper. The remaining question (Q.No.8) was answered wrongly by more than 60% students. This question was asked to test understanding of students. Students seem to have learnt the facts etc. from this unit of study

but could not develop understanding.

2.15 Overall achievement of students in essay type and short answer type questions.

In this section we propose to examine how our various categories of students actually fared in each cognitive objective in Section B of the question paper.

Achievement in Knowledge :-

In Section B of the question paper 8 marks out of 35 marks were allotted to test the simplest cognitive behaviour namely knowledge, involving the recall of information. The following Table (2.10) gives the performance of the various categories of our students in the objective of knowledge.

Table 2.10

S.No.	Categories of students	Total No. in each category	Percentage of students scoring mark			
			60% and above	45% and above but less than 60%	33% and above but less than 45%	below 33%
1.	First Div.	42	74%	22.5%	3.5%	-
2.	Second Div.	62	36%	31%	29%	4%
3.	Third Div.	75	2%	33%	35%	30%
4.	Candidates who failed	45	3%	-	22%	75%

We notice from the table that around 11% candidates who passed in the whole paper have failed in this area. 25% students, who failed in the whole paper, have passed in this area and even 3% candidates (who failed) could get 60% marks and above. 37% students scored 60% marks and above in this area as compared to 18.7% students who scored 60% and above

in the whole paper.

Achievement in understanding:- Table 2.11 shows the performance of the various categories of our students under the objective of understanding.

Table 2.11

S.No.	Categories of students	Total No. in each category	Percentage of students scoring marks			
			60% and above	45% and above but less than 60%	33% & above but less than 45%	Below 33%
1.	First Div.	42	43%	35%	17%	-
2.	Second Div.	62	10%	24%	54%	12%
3.	Third Div.	75	0	4.5%	29%	66.5%
4.	Candidates who failed	45	0	0	0	100%

From the table 2.11 we find that around 26% candidates who passed in the whole paper, have failed in this area. 52% students who scored 60% and above marks, in the whole paper have scored less than first class marks in this area. 66% students, who got second division marks in the whole paper, have scored less than second class marks in this area of objective. Similar is the performance of third divisioners. Thus we can conclude that in questions which do not involve memory but which really test students' ability to understand, candidates fare very badly.

Achievement in Application:-

In Section B of the question paper 4 marks out of 35 marks were allotted to test the objective of application. The following table (2.12) gives the performance of the various categories of our students under the objective.

Table 2.12

S.No.	Categories of students	Total No. in each category	Percentage of students scoring mark			
			60% marks & above	45% and above but less than 60%	33% and above but less than 45%	Below 33%
1.	First Div.	42	56%	35%	9%	-
2.	Second Div.	62	43%	45%	10%	2%
3.	Third Div.	75	9%	58%	19%	14%
4.	Candidates who failed	75	10%	45%	24%	21%

From the scrutiny of the Table 2.12 we observe that around 6% students, who passed in the whole paper, have failed in this area as compared to 11% and 33% in knowledge and understanding respectively. We may say that the performance is slightly better in this area, perhaps this is due to meager weightage given to this area or easy nature of questions. Consequently it may not reflect the correct position.

Achievement of Skill:-

10 out of 35 marks were allotted to test skill objective. The performance is given in table 2.13.

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Table 2.13

S.No.	Categories of students	Total No in each category	Percentage of students scoring marks			
			60% and above	45% and above but less than 60%	33% and above but less than 45%	below 33%
1.	First Div.	42	46%	22%	25%	-
2.	Second Div.	62	12%	20%	31%	37%
3.	Third Div.	75	0	4.5%	33%	62.5%
4.	Candidates who failed	45	0	0	3%	97%

We notice from the Table 2.13 that around 33% candidates who passed in the whole paper have failed in this area. This is a large percentage as compared to 11%, 26% and 6% respectively in knowledge, understanding and application. 54% First divisioners got less than first class marks in this area. This clearly speaks of the poor performance of candidates in this area.

2.16 Conclusions:-

The real state of affairs is indicated here. We have clearly seen that in questions which do not involve memory work or guess work but which really test students high order of mental ability, candidates have fared badly. We will now examine in more details the question and response pattern in Chapter III to ~~infer~~ whether questions were defective or any other cause can be attributed to the poor achievement of the students.

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C H A P T E R I I I

ITEM ANALYSIS AND ERRORS

3.1 Introduction:-

In chapter II we have analysed the question paper as a whole from different angles like weightage to objectives, content, form of questions, etc. We have also examined in some details how the candidates have fared in different areas of cognitive objectives and content, and how their performance in each area compares with their general performance. We shall now take up the item analysis in terms of processes involved in answering each question and specific errors committed by the students and suggest how they can be eliminated.

3.2 Item analysis of objective type questions:-

The analysis of students response to objective type items is a powerful tool for test improvement^{5,6}. Item analysis indicates (I) which item may be too easy or too difficult and (II) which may fail for other reasons to discriminate clearly between the better and poorer examinees. Item analysis sometimes, suggests why an item has not functioned effectively and how it might be improved. This type of information serves a distinctive purpose, which may be helpful to the conscientious teacher in improving both teaching and testing procedures. With this end in view we have carried out in this section the item analysis of the multiple choice type questions of section A of the General Science paper for the secondary examination 1972.

Many different processes of item analysis and many different⁷ indices of item quality have been developed by Frederick B. Davis.

We shall compute (I) an index of difficulty, (II) an index of discrimination and (III) study the response pattern on the item (i.e. the distribution of responses among the several alternative choices presented). The third one is done with a view to judging whether the item is functioning properly or not. (Ideally each distractor should attract some pupils, particularly those in the poorer group). If no one chooses a particular distractor, it may not be functioning properly.)

The task of obtaining information concerning the difficulty level and the discriminating power of a test question would indeed be a formidable one if this information were based upon the total group. It has been found, however, that satisfactory evidence concerning these characteristics can be obtained by considering ^{8,9} those who performed very well on the total test (The higher group) and the performance of only a portion of the group, namely, those who performed most poorly (the lower group). For our study we have taken under high group (or upper group) all the 42 students who secured First class marks in the total test and in the lower group all the 45 students who failed in the test. Therefore, the determination of difficulty and discrimination indices, as well as item response pattern, are based in this study upon these two fractions of the total group.

3.3 Difficulty index:-

The difficulty index is computed by dividing the number of pupils passing the item by the total number of pupils in the combined high and low group; i.e. in our case this number is 87(42+ 45). Therefore, item difficulty is determined using the ¹⁰ formula

$$\text{Difficulty Index} = \frac{R_h + R_L}{N_h + N_L} \dots\dots(3.1)$$

Where R_h - number of students who answered the item correctly in higher group.

R_L - number of students who answered the item correctly in lower group.

N_h - Total number of students in higher group

N_L - Total number of students in lower group.

We can see that the smallest possible value of the index is zero and the largest possible value is 1.00, the larger the value, the easier the item.

3.4 Index of Discrimination:-

While the difficulty level of an item determines in part its ability to discriminate between students of different achievement levels, items of the same difficulty level do not always discriminate equally well. The reasonably good level of discrimination is indicated by the difference in proportions of correct response between higher and lower groups. Therefore, the index of discrimination is computed by using the formula¹⁰

$$\text{Discriminating index (V)} = \frac{R_h}{N_h} - \frac{R_L}{N_L} \dots\dots(3.2)$$

where the symbols have the same meaning as in equation 3.1

3.5 Criteria of Grouping Questions for item analysis:-

We have seen in Chapter II that 12 multiple choice type questions in the paper 1972 were constructed to measure knowledge objective and 8 questions were constructed to test understanding objective. We have also seen that students fared well in questions testing knowledge as compared to questions testing understanding.

Therefore we have grouped all the 20 questions in these two groups for the purpose of item analysis.

Group A :- Q.No. 1,3,4,6,7,10,11,12,14,15,18,19

Group B :- Q.No. 2,5,8,9,13,16,17,20

The team also analysed each question in terms of mental processes involved in arriving at correct response. These processes are also present in the item analysis data.

3.6 Item analysis of group A:-

Question 1:- The analysis of 1st question is given below. The correct response is marked with an asterisk.

Table 3.1

Topic or Unit of study : Universe

Objective : Knowledge

Processes involved

Q.1 The planet farthest from the Sun is (A)* Pluto (B) Neptune (C) Venus (D) Jupiter

1. Recalls the order of the planets.

Response	A*	B	C	D	Omission	Difficulty	Discrimination
Higher Group	40	2	-	-		0.8	0.3
Lower Group	30	5	5	5			

This item is relatively easy but poor in discrimination, because 30 out of 45 in poorer group could also answer correctly. One final feature to be noted in connection with this item is that

all three distractors, or incorrect options, attracted at least a few members of the lower group. This means that all of them are somewhat plausible to those who do not know the answer.

From the response pattern we can also say that boys have learnt well the facts regarding planets.

Question 3 : The third question is asked from the Unit 'Plants and animals. Its analysis is given in Table 3.2

Table 3.2

Topic :- Plants and Animals					<u>Processes involved</u>	
Objective :- Knowledge						
Q.3 In the process of photosynthesis plants take (A)* Carbon dioxide (B) Nitrogen (C) Oxygen (D) Ammonia					Recalls the gas required for process of photosynthesis	
Response	A*	B	C	D	Ommission	Difficulty Discrimination
Higher Group	41	1	-	-		
Lower Group	39	2	4	-		
					0.92	0.026

The item in table 3.2 is too easy ($D=0.92$), and fails to discriminate ($V=0.026$). Another obvious difficulty with this question is that not one of the students in either or lower group selected the option D. This means the distractor D is not suitable and perhapes Hydrogen in place of Ammonia might have been a better distractor.

In this light we can say that this question is too easy, poorly discriminating and all the distractors are not effective. As such the item is of poor quality.

Q.No.4:- Table 3.3 presents the analysis of question 4 of Section A .

Table 3.3

Topic :- Universe

Objective :- Knowledge

Q. The planet known as morning star

(A) Mars (B) Mercury (C) Jupiter (D)* Venus

Response	A	B	C	D*	Omission	Difficulty	Discrimination
Higher Group	2	4	4	32		0.63	0.34
Lower Group	11	8	6	19			

This is somewhat difficult item ($D=0.63$) as compared to earlier two items. The item is relatively rather low in terms of discriminatory (but better than first two items) power. But still it is performing adequately, since it distinguished to some extent between the high and low group. We also note that all the distractors appear to be operating effectively.

Q.6 :- The analysis of this question is presented in Table 3.4

Topic :- Plants and Animals

Objective :- Knowledge

Q. Pencillin is obtained from

(A)* Fungus (B)Algae (Becilli (D) Cocci

Response	A*	B	C	D	Difficulty	Discrimination
Higher Group	29	7	6	-	0.55	0.22
Lower Group	19	13	8	5		

This is more difficult item than the previous one. However, it is also not good in discriminatory power. We can not say that all the distractors appear to be operating effectively.

Question No.7:- The item analysis of the question is presented in Table 3.5

Table 3.5

Topic:- Nutrition and Health

Objective : Knowledge

Processes involved

Q. The main function of Vitamin C is to

Recognises the functions of Vitamins

(A)* Strengthen the bones

(B) Help in reproductive process

(C) Help in clotting of Blood

(D) Keep liver healthy

Response	A	B	C	D	Ommission	Difficulty	Discrimination
Higher Group	22	3	11	5	1	0.52	0.022
Lower Group	23	7	9	5	1		

After looking at the index of difficulty (0.52) and the index of discrimination (0.022) of the item shown in Table 3.5, we can conclude that this is a comparatively difficult, poor discriminating item. We also note that a good number of students in higher

and lower groups were attracted to all distractors. This may perhaps mean that the question is ambiguous; or it may be that there is no correct answer; or perhaps the concept being tested here was not properly covered in the course of instruction. Question No.10 Table 3.6 represents the item analysis data of question No.10 which is from the topic Nutrition and Health

Table 3.6

Topic :- Nutrition and Health							
Objective : Knowledge							
Q. The acid formed in dental cavities due to bacteria is							
(A) Hydrochloric acid (B)Sulphuric Acid (C)Nitric Acid							
(D) *Lactic Acid							

Response	A	B	C	D*	Omission	Difficulty	Discrimination
Higher Group	2	-	-	40			
Lower Group	5	9	3	28		0.78	0.24

This item is relatively easy, However, it is discriminatory to some extent. All the distractors appear to be operating effectively. Thus the question seems to be alright.

Question 11:- Item analysis data given in Table 3.7 shows that this is a easy question and not doing the job of discrimination All the distractors seem to be operating quite well.

Table 3.7

Topic :- Nutrition and Health

Objective : Knowledge

Q. An example of the disease due to bacteria and virus is

(A) Colour blindness (B) Anaemia (C)*Typhoid (D) Beri-Beri

Recalls the name of the disease caused by virus bacteria.

Response	A	B	C*	D	Ommission	Difficulty	Discrimination
Higher Group	2	5	34	1		0.67	0.2
Lower Group	5	5	24	11			

Question No.12:-This question is from the unit 'Matter and Energy' and deals with the use of Zinc rod as one of the electrodes in the electric cell. The item analysis given in Table 3.8 shows that the item is very easy and has discriminatory power to some extent. All the distractors appear to be working. To my point of view the question, however, is faulty and needs revision.

Table 3.8

Topic :- Matter and Energy

Objective :- Knowledge

Q. Zinc is used in preparation of

(A)* Electric cell (B) Cycle (C)Railway trains (D) Tools

Response	A*	B	C	D	O	Difficulty	Discrimination
Higher Group	42	-	-	-	-	0.86	0.29
Lower Group	33	4	1	7			

Question No.14 :- The item deals with the topic of Nutrition and Health. Its item analysis is given in Table 3.9

Table 3.9

Topic :- Nutrition and Health

Objective :- Knowledge

Q: The main symptom of diphtheria is

(A)* Inflammation (B) High fever (C) Loose motions (D) Shivering Body

Response	A*	B	C	D	Omission	Difficulty	Discrimination
Higher Group	36	2	1	3			
Lower Group	26	10	4	5			
						0.73	0.29

This item again is quite easy and has very little discriminatory power. All the distractors appear to be operating effectively.

Question No.18:- This item is from the unit preparation of useful material. The item analysis given in Table 3.11 shows that the index of difficulty is 0.54 and index of discrimination is 0.55. The item is of moderate difficulty level and good power of discrimination. All the distractors appear to be operating effectively.

Table 3.11

Topic :- Preparation of useful material

Objective : - Knowledge

Q. An example of carbonic manure is

(A) Oil Cake manure (B) Ammonium sulphate (C) Superphosphate
(D) Potash sulphate

Response	A	B	C	D	Difficulty	Discrimination
Higher Group	35	2	2	3	0.54	0.55
Lower Group	12	14	12	6		

Question 15 :- This question is from the Unit Natural resources. Its item analysis is given in Table 3.9. We note that this item is quite difficult, though its discriminating power, is quite good.

Table 3.9

Topic :- Natural resources

Objective : Knowledge

Q. On fractional distillation of petrolium, petrol is obtained from

- (A) 50 C to 70 C (B)* 70 C to 90 C
(C) 90 C to 150 C (D) 150 C to 300 C

Response	A	B*	C	D	Ommission	Difficulty	Discrimination
Higher Group	4	21	10	7		0.33	0.32
Lower Group	9	8	17	11			

Stem of the question is not proper. In place of 'Petrol is obtained from' be substituted by 'Petrol is obtained between the temperatures.

Question No.19:- Item analysis of this question is presented in Table 3.12. This item again is of moderate difficulty level and relatively low in term of discriminatory power. It, still is performing adequately, since it distinguished well between

the high and low groups. Note also that all the distractors appear to be operating effectively.

Table 3.12

Topic :- Nutrition and Health

Objective : Knowledge

Q. The amount of sleep sufficient for adults is

(A) 12 hours (B) 10 hours (C) 9 hours (D)* 6 hours

Response	A	B	C	D*	Difficulty	Discrimination
Higher Group	2	5	4	31	0.58	0.33
Lower Group	4	10	12	19		

We can conclude from the item analysis of questions Grouped in A testing knowledge that majority of the questions were easy in nature and failed to distinguish between the better and poorer students. As such we can say that the quality of the questions is poor except Q. No. 4, 11, 18, 19. This also brings out an important point that our setters are not equipped well in the skill of construction of multiple choice type questions.

Item analysis of Questions of Group B:- In this section

we present the item analysis data and their interpretation for another 8 questions testing understanding of the students.

Question No. 2 :- This question is from the Unit 'The Earth and its mysteries' and deals with the special features of metamorphic

rocks. The datas are presented in Table 3.13.

Table 3.13

Topic :- The Earth and its mysteries

Objective :- Understanding

Question :- The special feature of metamorphic rocks is that

- | | |
|--|--|
| (A) They are the oldest | <u>Processes involved</u> |
| (B) They are found in layer | 1. Recalls the formation of different kinds of rocks |
| (C) *They are formed from other rocks | 2. Discriminates the process for the formation of morphic rocks. |
| (D) They are formed from lava of volcanoes | |

Response	A	B	C	D	Ommission	Diffculty	Discrimina- tion
Higher Group	4	6	31	1	-	0.45	0.57
Lower Group	17	19	8	9	1		

It is a difficult item since fewer than half of the students in the combined high and low group marked the correct answer. The difficulty index is 0.45. The discrimination index for this item is 0.57. The item is relatively good in terms of discrimination. We also note that all the distractors appear to be operating effectively.

Question 5:- The next item is again from the unit 'The Earth and its mysteries'. The item analysis for this question is given in Table 3.14

Table 3.14

Topic :- The Earth and its mysteries

Objective :- Understanding

Q. Stalactites and stalagmites are formed due to-

- (A) Rain Water
- (B) Dissolution of Calcium Carbonate in Water
- (C) * Dissolution of Calcium Carbonate in Carbonic acid
- (D) Dissolution of Calcium bicarbonate in Carbonic acid

Process involved

- i. Recalls the function of underground water
- ii. Understands the process of the formation of stalacties and stalagmites.

Response	A	B	C	* D	Difficulty	Discrimination
Higher Group	1	6	28	7	0.53	0.28
Lower Group	4	15	18	3		

We find from the table that the question is of moderate difficulty level and fairly bad in discrimination. All the distractors appear to be operating effectively. This question needs revision so that good discrimination can be obtained.

Question No.8:- The item analysis data of this question is given in Table 3.15

Table 3.15

Topic :- Plants and Animals.

Objective :- Understanding

Q. The method of improving the breed of mangoes is known as-

(A) Budding (B* Grafting (C) Mass Selection (D) None of the above.

Process involved

- (1) Distinguished between different Methods of improving the varieties through artificial method
 (2) Recognises the grafting method

Response	A	B *	C	D	Difficulty Discrimination	
Higher Group	22	18	1	1	0.40	0.058
Lower Group	20	17	1	6		

After looking at the index of difficulty (0.40) and the index of discrimination (0.058) of the item shown in Table 3.15, one can conclude that this is a difficult, poorly discriminating item. Why is it so ? Perhaps the question is too trivial or ambiguous, it may be that there is no correct answer; or perhaps the concept-being test here was not properly covered in the course of study. We find that the last point seems to be valid, as 24 out of 42 higher ability students could not arrive at correct answer.

Question No.9:- From the item analysis given in table 3.16 we find that this item is of moderate difficulty level and relatively good discriminating power. From the response pattern also we can observe that all the distractors are operating well. The question is quite satisfactory in construction as well as in difficulty and discriminatory power.

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Table 3.16

Topic : - Plants and Animals.

Objective :- Understanding

Q. On studying the embryos of fish, hen, rabbit and man we find that-

- (A)* Embryos of all these living beings are similar
- (B) All animals have developed from Aves.
- (C) All animals have developed from pisces
- (D) Man has originated from fish

Process involved:-

- (1) Recalls the different types and shapes of embryos
- (2) Compares the shapes of embryos of these animals
- (3) Interprets the shapes of these animals.

Response	A*	B	C	D	Difficulty	Discrimination
Higher Group	30	-	4	8	0.52	0.49
Lower Group	15	2	19	9		

Question No.13:- In Table 3.17 the item analysis data for this question is tabulated.

Table 3.17

Topic : - Nutrition and Health

Objective :- Understanding.

Q. For cleaning the wounds of skin we should use

- (A) Bleaching powder (B)* Detol (C) Kerosene oil (D) D.D.T.

Process involved:-

- i) Recalls the different types of antiseptics
- ii) Discriminate Detol as an antiseptic for the use of washing the wounds of skin

Response	A	B*	C	D	Difficulty	Discrimination
Higher Group	5	36	-	1	0.55	0.6
Lower Group	28	12	-	5		

We find from the table that the index of difficulty is 0.55 while the index of discrimination is 0.6. The question seems to be satisfactory, but one of the distractors seems to be not operating i.e. (C) kerosene oil. Although we know some times at initial stage we do clean with kerosene oil if no other antiseptic is available.

Question No.16:- This question is from the unit ' Natural resources. Its item analysis is given in Table 3.18.

Table 3.18

Topic :- Natural Resources

Objective :- Understanding

Q. Top soil is most fertile because

- (A) It is at the top (B) It receives maximum rain water
(C) It contains more manure (D)* It contains humus.

Process involved

1. Classifies the types of the soils
2. Discriminates the properties of the soil

Response	A	B	C	D*	Difficulty	Discrimination
Higher Group	1	-	1	40	0.69	0.52
Lower Group	5	5	15	20		

We find that the indices of difficulty (0.69) and validity or discrimination (0.52) for this item are quite satisfactory. We also note that all the distractors are somewhat plausible to those who do not know the answer, as such the item is quite satisfactory as also from the point of construction.

Question No.17:- This question is from the Unit 'Matter and Energy' and deals with the concept of good conductor of electricity. The item analysis given in Table 3.19 reveals that it is comparatively easy question, though its discriminating power is fairly satisfactory. All the distractors are plausible to those who do not know the answer. As such the question is satisfactory.

Table 3.19

Topic :- Matter and Energy

Objective :- Understanding

Q. Bad conductor of electricity is-

Process involved:

- (1) Distinguishes between the properties of good and bad conductors of electricity.

Response	A	B	C	D*	Difficulty	Discrimination
Higher Group	-	1	1	40	0.75	0.41
Lower Group	9	4	6	25		

Question No.20:- This item is from the unit 'preparation of useful material' and deals with the composition of alloy of aluminium used for utensils. We find from the item analysis data (Table 3.20) that the index of difficulty is 0.26 and the index of discrimination is 0.25. One can conclude that this

is a difficult and poorly discriminating item.

Table 3.20

Topic :- Preparation of useful material

Objective :- Understanding

Q. Aluminium utensils are made of an alloy of

(A) Aluminium, Copper and Zinc

(B)*Aluminium, Copper and Magnesium

(C) Aluminium, Copper and Iron

(D) Aluminium, Copper and Shell

Response	A	B*	C	D	Difficulty	Discrimination
Higher Group	20	16	2	2	0.26	0.25
Lower Group	21	7	5	12		

3.7 Concluding remark:- Thus we find from the item analysis of the multiple choice type questions that a large number of questions in group A are poor in quality and not operating properly. In group B 50% questions seem to be quite good. Therefore, we can say that the multiple choice type questions are not suitable to test the knowledge objective. This again strengthens the point that the multiple choice type test is to test the higher order mental processes and not the lower order. ^{4,8} We suggest that in future multiple type questions should not be included in a question paper to test knowledge. We can have few questions of this type to test understanding, Application i.e. higher order mental processes. By doing so, we hope to have better quality question paper.

3.8 Item analysis of questions other than Multiple choice type questions:-

Introduction:- Although it is not a common practice to subject questions other than Multiple choice Type or selection Type to item analysis, it is certainly advantageous to examine question in the light of the responses received in order to determine the validity of the question and of the question format. If the poorer students did as well or better on a particular question than the better pupils, the question does not contribute to the differentiation between good and poor pupils. Such a question might be ambiguous,. If nearly all the students did quite well (or quite poor) on the question, the degree of difficulty reduces the possibility that the question will discriminate.

It is possible to obtain analysis data on these questions in a manner similar to that presented for Multiple choice type questions. The index of difficulty would be the average number of points received on the question divided by the number of possible points. Thus D may be found by the use of the formula.

$$D = \frac{R_h + R_L}{X_m (N_h + N_L)} \dots\dots\dots (3.3)$$

Where R_h, R_L, N_h and N_L have the same meaning as in question 3.1. X_m is the maximum number of value points an individual could receive on the question.

In the present case we have allotted one value point to each processes involved in answering the question. Our team re-examined each question of an individual and awarded the value

We notice from the table that question No.21 and 23 are comparatively easy questions, though their discriminating power is fairly good. The other questions (Q.No.22 and 25) are somewhat too difficult and discrimination is also very good. Question No.24 has a moderate difficulty level and fairly good discriminating power.

We observe from the answers that quite a large number of students have written irrelevant answers to these questions. The frequency of students who attempted these questions but written irrelevant answers in the various categories of our students is given in the Table 3.22

Table 3.22

Categories of students in the whole paper	Total No in each category	Frequency of students					
		Q.No.	21	22	23	24	25
First division	42		1	7	1	12	4
Second division	62		14	16	2	33	15
Third Division	75		23	24	4	40	25
Candidates who failed	45		23	17	11	30	15

We observe that our best students have also indulged in writing irrelevant answers. This shows that boys have not understood or in their class these topics have not been covered properly. For example in question No.24 in which it is required to write any one disease caused due to occupations examinees have written the disease namely (I) High blood pressure (II) Typhoid (III) Beri-beri (IV) Malaria etc. This clearly shows that there

was no proper coaching in the class room so that boys could not understand the difference between these diseases and the diseases caused due to occupations. The question was clear and specific and there was no ambiguity.

When we examine the answers to question No.25, we find that a large number of examinees could not write that atom is electrically neutral, although they know that electron and protons are of opposite charge and their number is equal. This again points out that there was a lack of proper teaching in the class.

3.10 Analysis of short answer type questions:-

In all there were 10 questions of this type in the question paper and all the questions were grouped in Section B of the paper. Each question of this type carries two marks. Question No.4,6, 8 and 10 were asked to test knowledge objective, question No.5 and 9 were asked to test understanding objective, Question No.7 and 11 were asked to test application objective and question No.12 and 13 were asked to test skill objective. As such, now we shall examine these questions in the sequence of their objectives.

3.10(a) Analysis of Question No.4,6,8 and 10 testing knowledge:-

We will examine questions 4,6,8 and 10 in terms of difficulty level, discriminating power, mental processes involved and the response to these mental processes by the examinees.

Question No.4:- This question was asked from the Unit 'Universe' and deals with the phenomena occurring on the Earth due to the Sun. The item analysis is presented in Table

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Table 3.23

Topic :- Universe

Objective :- Knowledge

Question : Mention any two phenomena occurring on the Earth due to the Sun.

Process involved: Recalls any of the two phenomenon out of the following phenomena (1) Get heat and light (2) Day and night (3) Tides (4) Seasons. Thus we allotted two value points to this question. One value point for one phenomenon.

S.No.	Categories of students	Total No. of each category	No of students writing correct process			Index of Diffi- culty	Index of Dis- crimination
			Ist Process	2nd Process	irrelevant answer		
1.	First Division (Higher Group)	42	29	23	2		
2.	Second Division	62	37	35	2	0.43	0.31
3.	Third Division	75	34	15	17		
4.	Candidates who failed (Lower Group)	45	16	8	14		

After looking at the index of difficulty (0.43) and the index of discrimination (0.31) of the item shown in Table 3.23, one can conclude that this is a difficult, fairly discriminating item. But when we read the question, it appears to be quite a simple one and it is difficult to explain the response pattern of the students. We can only say that our better students

(scoring 60% marks in whole paper) also have neither read the text nor developed a scientific attitude.

Question No. 6:-

The question was from the unit 'plants and Animals' and asked to test knowledge of the use of vegetation for human beings. The item analysis is given in the Table 3.24.

Table 3.24

Topic :- Plants and Animals.

Objective :- Knowledge

Q:- Give any four uses of vegetation for human beings.

Process involved:-

Recalls the various uses of vegetation for human beings, out of any four are to be attempted.

Categories of students	Total No. of students in each category	Response in terms of processes					Diffi- culty	Disc- rimi- natio
		Ist Value point	IIInd Value point	IIIrd Value point	IVth Value point	Irrele- vant answer		
1. First Division (Higher Group)	42	29	35	37	37	-		
2. Second Division	62	57	52	54	51	-	0.66	0.32
3. Third Division	75	65	54	52	46	3		
4. Candidates who failed (Lower Group)	45	36	27	16	13	3		

This item is somewhat easy, though its discriminating power is reasonably fair. 13 students out of 45 students who failed in the whole paper could write correct answer to this

question. We can say that this part of the syllabus is well covered in the class room.

Question No.8:-

This question was from the topic preparation of useful material and deals with the preparation of glass. As there are five basic steps in preparing glass, we took these five steps as processes involved in answering the question. Each step is allotted one value point by the team, the maximum value points being 5, its analysis is as follows (Table 3.25).

Table 3.25

Topic :- Preparation of useful material

Objective :- Knowledge

Q:- How is glass prepared

Processes involved : Please see the appendix 7.

Categories of students	Total No. in each category	No of students who could reach to the process						Difficulty	Discrimination
		Ist	IIInd	IIIrd	IVth	Vth	Irrelevant answer		
1. First Div. (Higher Group)	42	31	31	19	14	7	-		
2. Second Div.	62	45	37	22	12	9	5	0.28	0.4
3. Third Div.	75	25	22	15	8	5	14		
4. Candidates who failed (Lower Group)	45	6	8	3	3	1	13		

This item is somewhat too difficult for the group and does discriminate between better and poorer. Only 7 students out of 42 students who scored 60% and above marks in the whole paper could write correct answer in terms of the processes involved. Thus we can say that this part of the syllabus is not properly covered in the course of instruction. This was a simple recall question and no higher order of mental processes was involved in answering the question.

Question No. 10 :- This item is again from the Unit ' preparation of useful material. Its item analysis is given below .

Table 3.26

Topic :- Preparation of useful Material

Objective :- Knowledge

Q. What do you understand by polymers ? Give any two of its use in Industry

Processes involved :- See Appendix 7

Categories of students	Total No. in each category	Response in terms of processes								Diffi- culty	Disc- rimi- nation
		Ist	IIInd	IIIrd	IVth	Vth	VIth	Irre- levant answer			
1. First Div. (Higher Group)	42	15	16	9	2	26	22	2			
2. Second Div.	62	14	19	16	4	29	30	8	0.17	0.3	
3. Third Div.	75	9	6	4	1	13	9	15			
4. Candidates who failed (Lower Group)	45	-	1	-	-	-	1	14			

From the analysis one can conclude that this item again is too difficult, though its discriminating power is fairly good. But when we read the question, it appears to be quite simple and needs the recall of the definition of Polymers and its uses. From the response pattern (which is poor) one may conclude that perhaps this part of the syllabus was not properly covered in the course of instruction.

From the study of these four short answer questions testing knowledge one may conclude that the Unit ' preparation of useful material ' (two questions) and ' Universe ' were not properly covered in the course of instruction. 3.10(b) analysis of question No.5 and 9 testing understanding:-

Question No.5:-

This item deals with the formation of natural caves and is from the Unit ' The Earth and its mysteries'. From the item analysis one may conclude that this is difficult question, though its discriminating power is very good. There were a large number of students who answered it in a irrelevant manner.

Table 3.27

Topic :- The Earth and its mysteries

Objective :- Understanding

Q :- How natural caves are formed ?

Processess involved - See Appendix 7

Categories of students	Total No. in each category	Response in terms of processes					Difficulty	Discrimination
		Ist	IIInd	IIIrd	IVth	Irrelevant Answer		
1. First Div. (Higher Group)	42	33	25	27	29	2		
2. Second Div.	62	25	22	25	25	9	0.345	0.65
3. Third Div.	75	11	11	16	13	17		
4. Candidates who failed (Lower Group)	45	-	1	2	3	23		

Question No.9:- This item is again from the Unit preparation of useful material. From the response pattern one may again conclude that this unit was not properly covered in the course of instruction.

Table 3.28

Topic :- Preparation of useful material

Objective :- Understanding

Q :- How does soap clean dirt ?

Process involved : See Appendix

Categories of students	Total No. in each category	Response in terms of processes							Difficulty	Discrimination
		Ist	IInd	IIIrd	IVth	Vth	VIth	Irrelevant answer		
1. First Div. (Higher Group)	42	33	32	27	14	14	27	2		
2. Second Div.	62	38	31	30	15	16	41	6		
3. Third Div.	75	32	20	18	11	9	32	16	0.4	0.37
4. Candidate who failed (Lower Group)	45	14	4	5	4	4	11	19		

3.10 (c) Analysis of Question No.7 and 11 testing Application :- Question No.7:-

This item was from the Unit ' Nutrition and Health'.
 We find from the response pattern that both the better and poorer students could write first and last processes correctly. This indicates that students have not mastered the Unit but have picked up some points here and there, Probably students might have also known these facts from day to day experience

Topic :- Nutrition and Health

Objective :- Application

Q :- If there is a patient of a contagious disease in a house
 how can the other members be protected from the disease ?

Processess involved :- See Appendix 7

Categories of students	Total No. in each category	Response in term of processess						Diffi- culty	Disc- rimi- nation
		Ist	IIInd	IIIrd	IVth	Vth	VIth		
1. First Div. (Higher Group)	42	42	20	10	9	8	24		
2. Second Div.	62	55	30	13	12	12	34	0.4	0.13
3. Third Div.	75	68	16	9	5	3	32		
4. Candidates who failed (Lower Group)	45	40	14	10	1	4	19		

Question No.11 :- This question was from the Unit 'Natural resources and asked to test application objective.

Table 3.30

Topic :- Natural Resources

Objective :- Application

Q: Mention one point of similarity and one point of difference between the formation of coal and petroleum.

Processess involved :-

1. Formation of coal and Petroleum at high temperature of the Earth.
2. Formation of Coal and Petroleum at high pressure inside the Earth
3. Coal is formed by wood
4. Petroleum is formed by sea animals and sea grass.

Categories of students	Total No. in each category	Response in term of processess					Diffi- culty	Discri- mina- tion
		Ist	IIInd	IIIrd	IVth	Irrele- vant ans- wers.		
1. First Div. (Higher Group)	42	20	18	22	24	5		
2. Second Div.	62	22	20	22	23	9		
3. Third Div.	75	10	8	12	9	19	0.29	0.42
4. Candidate who failed	45	7	3	3	5	17		

This item is somewhat difficult, though its discriminating power is fairly good. Over-all one may say that the question is reasonably good. A large number of third divisioners and candidates, who failed, wrote irrelevant answer.

3.10(d) Analysis of question No.12 and 13 testing Skill:-

Question No.12:- This item is of moderate difficulty level and does not discriminate well. We find that both the categories of better and poorer students failed to draw a proportionate and labelled diagram. This points out that instruction in the area of drawing skill was not proper.

Table 3.31

Topic :- Universe

Objective :- Skill

Q:- Draw a labelled diagram of a comet

Processess involved

1. Diagram of a comet
2. Cleanliness
3. Proportionate

Categories of students	Total No in each category	Response in term of Processess					Diffi- culty	Discri- mination
		Ist	IIInd	IIIrd	IVth	Irrelevant answer		
1. First Div. (Higher Group)	42	41	30	17	14	-		
2. Second Div.	62	50	25	9	31	6	0.51	0.2
3. Third Div.	75	61	23	11	25	3		
4. Candidate who failed (Lower Group)	45	29	22	14	11	4		

Question No. 13:-

This item is somewhat difficult and does not discriminate well (From the table 3.32). We find that both the categories of better and poorer students failed to draw a proportionate and labelled diagram.

Table 3.32

Topic :- Plants and Animals

Objective : Skill

Q :- Draw a diagram of any one Xerophytic Plant.

Processess involved :

1. Diagram of any one Xerophytic Plant
2. Cleanliness
3. Proportionate
4. Labelled.

Categories of students	Total No in each category	Response in term of Processes					Diffi- culty	Discri- mina- tion
		Ist	IIInd	IIIrd	IVth	Irrele- vant ans- wer		
1. First Div. (Higher Group)	42	34	26	21	12	2		
2. Second Div. "	62	45	32	15	18	3	0.45	0.21
3. Third Div.	75	33	25	13	11	10		
4. Candidate who failed (Lower Group)	45	29	17	14	4	8		

3.11 Analysis of Essay type question:-

Essay type questions are particularly asked to test the skill of examinees in written expression and their ability to think through problems and organise their thought in a clear and logical manner. Thus there is a certain degree of freedom of response. As such examinees produce answer which are neither completely right nor completely wrong. Our team developed the answer of each essay type question point by point (i.e. processes involved) in a sequential manner and scrutinized the sample copies in this light, giving one value point for each point or process written by the student, our analysis is given below, is based on the above lines.

In the question paper under review there were three essay type questions, each carrying 5 marks. Each question had an internal option and the alternate question was again asked from the same unit of study and also to test the same cognitive objectives. We find that essay type questions in the paper

were asked to test understanding objective carrying 3 marks and skill objective carrying 2 marks.

Question No. 1:-

The question reads as

Explain, with the help of a diagram of Fortin's barometer, how atmospheric pressure is measured with it.

Or

Explain, with the help of a diagram, the working of a maximum minimum thermometer.

Both questions were from the unit of study 'Meteorology'. A majority of students in each category tried to answer the alternate question which deals with maximum and minimum thermometer.

Table 3.34 shows the analysis data for the question which deals with Fortin's barometer.

Topic :- Meteorology

Objective :- Understanding (3 marks), Skill (2 marks)

Question :- Explain, with the help of a diagram of Fortin's barometer, how atmospheric pressure is measured with it.

Processes involved : See Appendix 7

Category of students	Total No. in each category	Response in terms of processes									Diffi- culty	Discri- mina- tion
		1	2	3	4	5	6	7	8	9		
1. First Div. (Higher Group)	5	5	4	3	4	4	4	3	4	1	0.29	0.55
2. Second Div.	10	9	7	7	6	7	5	6	3	1		
3. Third Div.	14	10	6	3	6	8	6	6	2	3		
4. Candidate	16	6	4	3	4	3	4	1	1	-		

We find that the question is somewhat too difficult, though its discriminating power is fairly good. 100% of First class, 90% of the Second class, 71% of the third class students and 31% of the candidates who failed in a whole paper could draw the diagram, but the majority of the students could not make it clean, proportionate and labelled one. Our superior students also could not do so. This may be due to the fact that the question appears to be silent regarding these points. Therefore, if the item were constructed as follows, it would have given a desired response at least by better students.

" Explain, with the help of clean, proportionate and labelled diagram of a Fortin's barometer, how atmospheric pressure is measured with it.

On scrutiny we find also that examiners have wrongly marked. This may be due to ignorance on the part of the examiners or they were quite lenient or careless. This has resulted in unreliable marking.

We also notice that the last process i.e. to present height of a mercury column in terms of air pressure is not known to the examinees.

From the response pattern one can conclude that this topic either was not properly covered in the instruction or the boys did not understand the topic.

The written expression and logical arrangement of the response was too poor.

Table 3.35 shows the analysis for the question which deals with the working of a maximum minimum thermometer.

Table 3.35

Topic :- Meteorology

Objective :- Understanding (3 marks), Skill (2 marks)

Question :- Explain, with the help of a diagram, the working of a maximum and minimum thermometer.

Process involved - See Appendix 7

Categories of students	No of students in each category	Response in terms of processes										Difficulty	Discrimination
		1	2	3	4	5	6	7	8	9	10		
1. First Div. (Higher Group)	37	27	21	12	21	17	25	19	24	16	14		
2. Second Div.	52	36	25	12	21	15	19	23	22	19	15		
3. Third Div.	61	34	31	13	22	13	20	16	17	10	7	0.41	0.35
4. Candidate who failed (Lower Group)	26	14	9	8	7	2	6	4	3	1	-		

After looking at the index of difficulty (0.41) and the index of discrimination (0.35) of the question shown in Table 3.35, one can conclude that this is a difficult, reasonably good discriminating question. We can again notice that the diagram drawn was not proportionate, not properly labelled and clean. Superior students' answer also suffer from these defects. Only 26% of the total students, who answered this question, could write the first process. Quite a large number of students wrote irrelevant answer such as the description of the apparatus etc. and still examiners have awarded marks. Thus there is complete subjectivity in scoring

Although a large number of students have attempted this question, but the quality of response has been poor.

Question No.2 :- The analysis of the question dealing with telephone is given in Table 3.36.

Table 3.36

Topic :- Transport and Communication

Objective :- Understanding (3 marks), Skill (2 marks)

Question :- Explain with the help of a diagram of transmitter and receiver, how do we talk on a telephone.

Processess involved :- See Appendix 7

S.No.	Categories of students	No of students in each category	Response in terms of processess													
			1	2	3	4	5	6	7	8	9	10	11	12	13	14
1.	First Division (Higher Group)	22	11	4	3	7	14	12	3	7	5	6	3	2	3	7
2.	Second Division	31	10	8	3	6	11	8	1	-	5	5	1	3	2	5
3.	Third Division	40	3	-	-	-	5	1	-	1	2	1	-	-	1	1
4.	Candidate who failed (Lower Group)	21	4	4	4	4	1	-	-	-	-	-	-	-	-	-

We have not calculated the index of difficulty and index of discrimination. After looking at the response pattern, one can conclude that majority of students do not know the answer, 50% of the superior students draw the diagram, though their diagrams were dirty, not labelled and improportionate.

In Table 3.37 analysis of the question dealing with Wireless communication system is given.

Table 3.37

Topic :- Transport and communication

Objective :- Understanding (3 marks), Skill (2 marks)

Question :- Explain with the help of a diagram wireless communication system.

Process involved :- See Appendix 7

Categories of students	Total No. in each category	Response in terms of processes																	
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1. First Div. (Higher Group)	11	3	2	3	3	7	8	3	4	5	3	-	3	4	4	4	3	4	4
2. Second Div.	23	4	1	2	1	2	4	1	1	-	-	2	2	2	2	1	-	4	4
3. Third Div.	22	4	1	1	2	2	2	-	-	-	-	1	-	-	-	-	-	1	1
4. Candidate who failed (Lower Group)	23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

After looking at the response pattern, one may conclude that no one knows the answer to any extent. This is shocking. Only one may conclude that this topic was not properly covered in the course of instruction. Perhaps teachers also do not know the topic or the topic may not be clear in the text book.

Question No.3:- Similar item analysis, of the question dealing with chain reaction and dealing with external combustion engine is given in appendix.

Around 5% of the total students, who attempted the question dealing with chain reaction could draw diagram of chain reaction. Hardly 1% students know how we get energy in an atomic reactor.

More than 50% students answered the question dealing with external combustion engine. But again quality of answer is fairly poor and one may conclude that students do not know the answer or

3.12 Conclusion :-

In conclusion, one may sum up that a majority of students do not know the answer of these essay type questions. Perhaps this may be due to poor instruction or lack of homework. Boys fail to organise their thought in a clear and logical manner. They do not know how to write responses in their own words.

3.13. Students Errors and suggestions to Eliminate them:-

In this Section we have taken up specific errors committed by the examinees and suggested how they should be eliminated. On the basis of analysis carried out, common errors and mistakes have been divided under the following categories:-

1. Errors related to drawing of diagrams,
2. Errors related to misunderstanding or poor understanding of some important terms and concepts
3. Mistakes committed on account of wrong understanding and lack of understanding of basic principles.
4. Errors in organising the response in a systematic and logical order.
5. Habit of over writing, poor hand writing, dirty working.
6. Poor expression
7. Errors in spelling the Scientific terms,
8. Habit of repetition and negative answering.
9. Irrelevant answers.

The study on these errors and corresponding suggestions are as follows:-

(1) Errors related to drawing of diagram:-

In the question paper examinees were asked to draw five diagrams and each carrying two marks. We expect from a examinee to draw a correct, clear, proportionate and labelled diagram.

From the response pattern as given in Table 3/31/3.32,3.34, 3.35,3.36,3.37 and appendix 9, we calculated for each question percentage of students drawing correct, clear, proportionate and labelled diagram. The results are given below:-

Table 3.38

Type and Q.No.	Correct	Clear	Proportionate	Labelled
Essay Q.No. 1 Sec. B	66%	46%	35%	44%
Or				
" Q.No. 1 "	63%	43%	25%	40%
" Q.No. 2 "	24.5%	14%	8.7%	14.2%
Or				
" Q.No. 2 "	14%	5%	6.3%	7.7%
" Q.No. 3 "	61%	33%	27%	40%
Or				
" Q.No. 3 "	32%	20.7%	11%	20%
Short A.T.Q.No.12	80%	44.6%	22.3%	36%
-do- 13	63%	44.6%	28%	20%

We note from the above that majority of students who could draw a correct diagram failed to draw clear, proportionate and labelled diagram. Four (Q.No.1,2,3,13) out of five questions were silent regarding these points, as such students might have not considered necessary to make labelled and proportionate diagram. Therefore it is suggested that setters should write in clear language what is required by the examinee. One may also say that both the teachers and students are not conscious of the fact that diagram should be clear, proportionate and labelled one. Because our better students have also not drawn clear, proportionate and labelled diagram. The teachers should draw on blackboard

in class room. All the students must be encouraged to draw diagrams in home task also.

3.17 Errors related to misunderstanding and poor understanding of some important terms and concepts.

Such errors are largely committed due to students in ability to understand the question itself, confusing two apparently similar terms and concepts. The terms and concepts required as per question are not worked properly.

A few examples noted below have been taken from this study:-

- (a) Describing telegraph in place of telephone.
- (b) Describing telegraph in place of wireless communication
- (c) Describing internal combustion engine in place of external combustion engine.
- (d) Describing kinds of glass in place of preparation of glass.
- (e) Describes construction of the instrument when only 'working' was asked.
- (f) Explains the details of figures when only drawing of a diagram was asked.

The detailed analysis is as follows:-

- (a) Following table will show number of examinees who committed the error of describing Telegraph in place of Telephone- refer question No.2 of Section B of the Paper :-

Categories of students	First Divisioners	Second Divisioners	Third Divisioners	Failures
i) Total No. in each category	42	62	75	45
ii) Error committed by	8	12	20	-
iii) Percentage of students who committed this error	19.0%	19.3%	26.7%	-

this error is a serious matter and shows how poor is the learning process in the schools. Failures have hardly attempted this question and hence the data can not be interpreted. The failures neither knows 'Telephone' nor 'Telegraph.'

- (b) Following table also proves that ability to understand the term Telegraph is poorly and wrongly understood as wireless communication:-

Table 3.39

Categories of students		First Div.	Second Div.	Third Div.	Failures.
i)	Total No. in each category	42	62	75	45
ii)	No of students who committed error	4	6	21	-
iii)	Percentage of students who committed this error	9.5%	9.7%	26.7%	-

Again it is established that good students are also committing this type of error.

Error No.(1) and (2) cited above if grouped together establishes that this error is much common amongst all grades of pupils.

- (c) Number of students who committed the error of describing internal combustion engine in place of external combustion engine, is as follows:-

Table 3.40

Categories of students		First Div.	Second Div.	Third Div.	Failures.
i)	Total number of students who attempted	14	16	30	-
ii)	No of students who committed error	2	6	12	
iii)	Error PERCENTAGE	14.3%	37.5%	40%	

This question has not been attempted by majority of students and those who attempted have described so wrongly.

The frequency of students, who have described

- (d) In question No.8 kinds of glass in place of preparation of the glass is as follows:-

Table 3.40

S.No.	Categories of students	First Div.	Second Div.	Third Div.	Failures
1.	Total No. of students	42	62	75	45
2.	No of students who committed error.	-	-	17	22
3.	Percentage	-	-	22.7%	40.9%

Such a simple question has been misunderstood by pupils. This shows that simple knowledge is not properly acquired by pupils. Large number of pupils are failing in such a simple question.

- (e) The error of describing the construction in place of working of an apparatus has been the most common error. Number of students in each category is as follows:-

Categories of students	First Div.	Second Div.	Third Div.	Failure.
i) Total No. in each category	42	62	75	45
ii) Those who committed error	16	5	6	32
iii) Percentage	38.1%	8.1%	8.0%	71.1%

First divisioners have described construction in addition to the working of the apparatus, shows how they mis-understood the question. It is just possible that they had time enough to mention the construction of the apparatus. Second and Third divisioners

have also been mistaking. Failures have tried to describe the construction and that too so poorly expressed, that they seem to have no knowledge of the apparatus.

- (f) In the questions where only diagram was asked, pupil have explained in words also as is evident from the table . 3.42

Table 3.42

Categories of students	First Div.	Second Div.	Third Div.	Failures
i) Total	42	62	75	45
ii) Those who committed this error	5	12	30	23
iii) Percentage	11.9%	19.3%	40%	50.1%

This is how pupils mis-understand the questions.

- (3) Mistakes committed on account of wrong understanding or lack of understanding of basic principles

Quite a lot of mistakes are committed on account of lack of clear understanding of a principle and laws. Some examples are noted below:

- a) The principle of vernier scale is not understood by 70% students who attempted this question, As such they could not write that correct height of Mercury column in a Fortin's barometer is
- main scale reading + vernier scale reading.
- b) Atmospheric pressure is equal to the weight of mercury column supported by the atmospheric pressure per square centimeter and therefore it is equal to the height of mercury column in a barometer X density of the mercury X acceleration due to gravity. This fact is not well

- c) Due to increase and decrease of temperature, the Alcohol expand and contract respectively. This fact seems to be not known to 50% students and thus their answers to question No.1 regarding Maximum and Minimum Thermometer were wrong.
- d) About 45% students do not know or understand that one form of energy can be converted into another form of energy. As such students answers to question No.2, were not proper.
- e) Atom is electrically neutral, due to this fact number of electrons and protons are equal in any atom of the element. The fact that each electron carries one unit of negative charge and proton carries one unit of positive charge was omitted.
- f) Disintegration and Chain reaction is due to bombardment of neutrons and not due to protons as committed by some pupils. The number of students who committed errors a, b, c, d, e and f is given in Table 3.43
- Category wise errors committed in principle

Table 3.43

Errors	First Division			Second Division			Third Division			Failures		
	(a)	(b)	(c)	(a)	(b)	(c)	(a)	(b)	(c)	(a)	(b)	(c)
(a)	6	4	66.7%	5	3	60.0%	2	2	100%	5	5	100%
(b)	6	3	50%	5	4	80%	2	2	100%	5	5	100%
(c)	36	10	27.7%	57	22	38.6%	73	53	72.6%	40	32	80%
(d)	32	4	10%	46	17	36.9%	60	32	53.3%	15	12	80%
(e)	42	2	4.7%	62	19	30.6%	75	49	65.3%	45	34	75.5%
(f)	20	2	10%	24	8	33.3%	14	10	71.4%	4	4	100%

Either part of question No.1 related to error No.1 and 2 has been attempted by a few examinees as compared to the 'or' part of question (error No.3) This shows that knowledge based on atmospheric pressure and use of Fortin's barometer was not so confidentially known to examinees which tempted them to solve the other question. The comparative study reveals that errors No.1 and 2 are committed by almost all those who attempted the question. Error No.6 proves that this content was not well understood by even first divisioners and so they attempted the other part. Those attempted have committed errors in principle.

4. Errors in organising the responses in a systematic and logical order.

Essay type and short answer questions where more than one processes are involved, it was noticed that pupils have not responded in a systematic form. The sequence was neglected. In some responses the processes involved were not in logical sequence and in some other responses the proper words required to be used were neglected.

Some of the illustrations from the study are as follows:-

1) In question one, while describing the use of index in Maximum and Minimum Thermometer, the temperature is read with the help of index. Most pupils failed to write the word ' lower part of the index being used to read.

2) The order in which functions of 'D' valve of the 'engine' were to be put were missed and simply responded 'piston' is pushed by steam in D valve. The pupils should have mentioned that when piston moves onward the other end of the valve is closed and steam enters from the former valve and so on.

3) While explaining the working of telephone, it was hardly mentioned that there is a cause and effect relation ship of

sound with electric energy i.e. the rise and fall of current is according to vibrations of sound.

4) Functions of wire less was hardly expressed in the order expected from the examinee. Formation of modulated waves, feeble currents were omitted by even first divisioners who attempted this question.

In general all the three essay type questions (six, including internal choice) were poorly responded in the sequential way.

6. Expression part of the pupil is much poorer

It has been noticed that though the facts, terms, are known to the pupils they are not able to put them in their own words to give the exact meaning which they really wants to convey.

For example, few errors of expression as noticed in the study are noted below:-

- 1) Representing atmospheric pressure in terms of height of mercury column- weight of mercury per square cm.
- 2) In the working of Maximum and Minimum Thermometer, reading is taken with the help of 'lower' part of metallic index. The word ' lower and index reads 'maximum ' or minimum temperature are usually omitted.
- 3) In the working of telephone, the variation in current due to variation in resistance was hardly mentioned by pupils.
- 4) In the 'working of ' Wireless set' the electromegnetic waves are extrapolated for ' higher frequency'. This word ' higher frequency ' was mentioned in the responses in much irrelevant manner.
- 5) In the nuclear-fission, 'how ' chain reaction ' is

developed was not expressed in a short and concise manner.

- 6) Repetition of the same matter in the same language or different language also proves that the pupils lack in expressing the facts.

7. Errors in spelling the scientific terms:-

Though General Science teaching does not aim to test the spelling and ability acquired in language yet it is much more essential that correct terminology is known to the pupils. From the study, it revealed that the examinees failed to put proper spelling for the following words:-

1. Seismograph. It was spelled much badly by even second divisioners. The unwanted words were Thermograph, strosbos-scope, spherograph, Geismograph, Graphmeter, Simsograph, Simograph, Siscograph were spelled.
2. Photo-synthesis was spelled as ~~फोटोलेखन~~, ~~सन्तैसन~~, ~~फोटो-लेखन~~, ~~उत्पन्न~~
3. Molecule for atom,
4. neutron is negative.
5. Particles as substance
6. Electric energy for electric current
7. Soundwaves for sound energy,
8. Disintegration as ~~उत्सर्जन~~ (emission).
9. Caustic for caustic soda; soda of soap for caustic soda.
3. Habit of Repetition and negative answering:-

This type of error was common in third Divisioners and failures, probably, due to the fact they had time to sit in examination hall and were not remembering the answers. The other reason can be, that pupil consider that marks are given according to the size of the answer. It is therefore suggested that teachers should discourage this habit, and prepare the pupils for proper, concise

answer, relevant to question. Pupil must know clearly that marks are not given according to the size of the answer.

9. Irrelevant answers:-

The irrelevancy was noticed in many questions of the paper under study. Almost all categories of students in one or the other question have given irrelevant answers. Some examples of irrelevant answers are as follows:-

- i) For siesomograph the names responded were photograph, stethoscope, stalagmite. This illustration further reveals that pupil is neither clear about Siesmograph nor with other irrelevant names given by him.
- ii) Reasons given for 'central part of the earth behaves as solid and liquid both ' are- that temperature and pressure are equal, high boiling point of earth, plants and trees, atmospheric pressure.
- iii) While recalling the occupational disease, one of the irrelevant answers were Malaria, Diphtheria, Small pox Typhoid, etc.
- iv) Alcohol expands on cooling.
- v) Uses of instruments (engine, maximum minimum thermometer telephone) were expressed in place of their working.

9. Habit of over- writting, poor hand writing and dirtyness.

It is generally observed in all the areas, now that pupil are less confident, less careful and lacks the interest in presenting the things beautifully. So was observed in this study.

In the Multiple choice Questions, where examinee is to write only one letter out of A,B,C and D, there are also over-writing is there. The over writing is so shabby that none of the letter can be ascertained. Descredit should be given to such

examinees, uniformly by imparting clear instruction that no credit will be given to over-writing. The difficulty ^{of} over-writing in assessment becomes still more when some numerals are involved.

This habit of over writing is to be discouraged right from lower classes during the class room teaching.

Though answer books are provided with lining yet examinees do not use these lines to answer the question. Proper headings, headlines, paragraph, point to point answer and systematic way of presenting the matter is hardly observed. Even first divisioners were lacking in this. Only 5% of the examinees can be said to have their answers beautifully and systematica ly.

This part of error can not be rectified when the pupil reaches in class IX but requires to be pointed by the teachers dealing the pupil right from the beginning.

2 /

C H A P T E R IV SUMMARY AND CONCLUSIONS

4.1 Introduction:-

The present investigations have been mainly concerned with the analysis of the question paper of General Science for the Secondary Examination 1972 and the study of students' responses to each question set in the paper. This is done to know how far have the newly framed instructional objectives like knowledge, understanding application and skill been actually tested in the General Science question paper of Secondary examination 1972, how far these objectives have been actually achieved by the examinees and what were the significant errors have been made by the students. This study also aimed to know the areas in which instruction was especially found poor and needs improvement and to the extent to which questions discriminate between the better and poorer examinees. The other main objective of this study was to provide directions for improving the design and construction of the question paper so it can be made more reliable in measuring the achievement of specific instructional objectives relating to particular units of syllabus in General Science. With these purposes in view two hundred twenty four answerbooks of the candidates who appeared in General Science paper of the Secondary Examination, 1972 were selected. The same percentages of the first, second and third class students and those who failed were included in their sample of 224 answer books as in the actual results of the candidates in the whole paper. In this chapter the significant results of the investigations, described in previous chapters, are summarized and some suggestions for improving the design and construction of test paper, improvement since teaching in the class room and its measurement, are presented.

4.2 Coverage of objectives:-

The analysis of the question paper reveals that there was a much variation in weightage (i.e. percentage of marks allotted in terms of total marks for the section) to various objectives in Section A and Section B of the question paper (see table 2.2) For example we find that 53.3% marks (i.e. 8 marks out of 13 marks were allotted in Section A as compared to 23% marks (i.e. 3 marks out of 35 marks) allotted in Section B to test knowledge objective. Similarly in Section B 28.4% marks (i.e. 10 marks out of 35 marks) were allotted as compared to 0% percent (i.e. 0 marks out of 15 marks) in Section A to test skill objective. Therefore, it is suggested that equal weightages to objectives be given in Section A and Section B.

We also notice that in the whole paper more weightage (i.e. 20% marks or 10 marks out of 50 marks) was given to test skill objective and less weightage (i.e. 38% marks or 19 out of 50 marks) was given to test understanding objective. It is, however, suggested that the weightage given to skill objective be decreased and more wieghtage be given to understanding objective. We recommend in the following Table the distribution of marks to various objectives in Section A and B and in the whole question paper for an improved question paper in General Science.

Categories of objectives	Marks in Section A	Marks in Section B	Marks in whole question paper
1. Knowledge	11(32%)	5(32%)	16(32% of the total marks)
2. Understanding	17(48%)	7(48%)	24 (48% -do-)
3. Application	1.5(10%)	3.5(10%)	5(10% -do-)
4. Skill	1.5(10%)	3.5(10%)	5(10% -do-)

4.3 Coverage of content:-

It is observed from the table 2.3 of chapter II that marks are evenly distributed over various units of instruction i.e. approximately required weightage has been given to various units of study. One may also notice that marks are also evenly distributed over various units of syllabus in regard to objectives. Therefore, we recommend that the present trend be continued in the question paper.

4.4 Arrangement of questions:-

The analysis indicates that within each section of the question paper, items of similar content are not grouped together. Thus paper appears to the examinees as fragmented and they cannot attack it in an integrated fashion. It is suggested that items of similar content be grouped together and further items from a particular content be arranged according to their difficulty level. It is usually good to progress from the easy to more difficult items.

4.5 Marking Scheme for the Examiners:-

The marking scheme lacks in details, which has resulted into a subjective marking. Thus objectivity has not been built up as desired in public examinations. There were quite a good number of cases in which examiners have wrongly marked the individual questions as noted in chapter III. Therefore, we strongly suggest that more detailed marking scheme or the model answers which may be in the shape of processes involved as done by our team to each question be provided to examiners to avoid too much subjective marking, otherwise we will be unable to ensure uniformity in marking by different examiners.

4.6 Scoring pattern:-

The analysis of the scoring pattern of an individual students in two sections of the question papers denotes that marks scored by an individual in Section A were much more than in Section B. In section A 82 students out of 224 students secured above 60% marks as compared to 22 students out of 224 students in Section B. Only 43 out of 224 students failed in Section A as compared to 155 students out of 224 students failed in Section B.

From the table 2.7 and 2.8 of chapter II we have seen that questions testing knowledge objective in Section A have been answered correctly by more than 60% students who passed in the whole paper. The questions testing understanding objective in Section A have been wrongly answered by more than 50% students who passed in the whole paper. Thus one can conclude that the performance is much better in questions where memory or guess work can play an important part. Therefore, it is suggested the

4.7 Item analysis :-

In chapter III we have presented the data of item analysis. Calculated indices of difficulty and discrimination are summarised in table 4.2 for Section A of the question paper.

Table 4.2

S.No.	Question No and type of question	Objective	Difficulty Index	Discrimination index	Remarks
1.	1(MCT)	Knowledge	0.8	0.3	easy, poor in discriminating.
2.	3(MCT)	"	0.92	0.026	Very easy, very poor in discriminating.
3.	4(MCT)	"	0.63	0.34	Reasonably good item.

1	2	3	4	5	6
5.	7(MCT)	Knowledge	0.52	0.022	moderate, very poor in discriminating.
6.	10(MCT)	"	0.78	0.24	easy, poor in discriminating.
7.	11(MCT)	"	0.67	0.2	easy, poor in discriminating.
8.	12(MCT)	"	0.86	0.29	very easy, poor in discriminating
9.	14(MCT)	"	0.73	0.29	very easy, poor in discriminating
10.	15(MCT)	"	0.54	0.55	moderate, good in discriminating, good item.
11.	18(MCT)	"	0.33	0.32	very difficult, reasonably fair in discriminating
12.	19(MCT)	"	0.58	0.33	easy, reasonably fair in discriminating.
13.	21(VST)	"	0.62	0.7	easy, good in discriminating.
14.	24(VST)	"	0.5	0.46	reasonably good item.
15.	2(MCT)	Understanding	0.45	0.57	Difficult, good in discriminating.
16.	5(MCT)	"	0.53	0.28	moderate, poor in discriminating.
17.	8(MCT)	"	0.40	0.058	Very difficult very poor in discriminating
18.	9(MCT)	"	0.52	0.49	moderate, good in discriminating.
19.	13(MCT)	"	0.55	0.6	reasonably good question.
20.	16(MCT)	"	0.69	0.52	easy, good in discriminating
21.	17(MCT)	"	0.75	0.4	easy, reasonably good in discriminating.

1	2	3	4	5	6
22.	20(MCT)	Understanding	0.26	0.25	Very poor question
23.	23(VST)	" "	0.75	0.44	Very easy, good in discriminating
24.	25(VST)	" "	0.36	0.46	Poor question
25.	22(VST)	Application	0.3	0.5	Very difficult, good in discriminating.

We find from the table that majority of the items are ineffective (non discriminating) because they are too difficult or too easy. Only a few items appear to be reasonably good. Thus one can conclude that the objective type questions set in the question paper of General Science, 1972 are not proper and demand efforts to improve the construction of these questions. Hence the scores of the examinees may not give us true picture about their achievements in the subject. The present question paper although may be of improved pattern but due to poor quality of the questions it is not doing its job.

We suggest that a large number of different type of objective type questions be prepared by subject experts and be administered and item analysis got done. Suitable question be pooled together in a question Bank and examiners be requested to use these questions.

4.8 Short answer type questions:-

In Section B of the paper there were 10 short answer type questions, each carrying two marks. Calculated indices of difficulty and discrimination for these questions are summarised in Table 4.3

S.No.	Question No.	Objective	Difficulty Index	Discrimination index	Remarks
1.	4	Knowledge	0.43	0.31	Difficult, poor in discriminating
2.	6	"	0.66	0.32	easy, poor in discriminating.
3.	8	"	0.28	0.4	Very difficult reasonably good in discriminating
4.	10	"	0.17	0.3	too difficult, poor in discriminating.
5.	5	Understanding	0.345	0.65	difficult, good in discriminating
6.	9	"	0.4	0.37	difficult, reasonably fair in discriminating.
7.	7	Application	0.4	0.13	difficult, very poor in discriminating.
8.	11	"	0.29	0.42	too difficult, good in discriminating.
9.	12	Skill	0.51	0.2	moderate, very poor in discriminating.
10.	13	"	0.45	0.21	difficult, very poor in discriminating.

From the inspection of the table one can conclude that majority of the questions appear to be difficult and poor in discriminating between better and poorer examinees. Thus these questions also fail to give us true picture of the achievements of the students. The Board's result is, therefore, misleading.

The situation regarding essay type questions is still more shocking. From the table 3.34, 3.35, 3.36, 3.37 one will conclude that majority of the students do not know the answer of essay type questions. We also find that examinees failed to organise their thoughts in a clear and logical manner. They did not know how to

From the study of responses to an individual question one may conclude that the students, although they might have passed in the whole paper, have done badly, in achieving the goals of teaching General Science. The study team is of the opinion that this may be due to the lack of proper teaching in the class room. Therefore, the only real solution of the problem is the improvement of the quality of the instruction in the class - room. The Board can help the teachers by providing teacher guides and work books for the students.

4.10 Students' Common Errors:-

Apart from the specific errors (See section 3.13) involved in answering the questions of the paper, the effort to list all types of errors found in whatever the students wrote has not been very successful. While it gives a fairly good idea of the various types of errors made by the students it cannot give us any exact idea of the percentage of students making each type of error. In answering essay and short answer type questions both better and poorer students fail to organise the response in a clear and logical manner. Our good and bad students have indulged in overwriting and repetition. Majority of the students wrote the construction of the apparatus in more detailed than the working as required by the questions. Students seems to be in habit of writing whatever they knew about the topic from which the question has been asked. This problem can be solved by encouraging students to do good amount of home work and properly corrected by the teacher.

Suggestion:- 1. The question paper should have objective, very short answer, essay and short answer type questions. The present practice be continued, but we suggest the following breakup of

questions in each category of questions.

		Proposed No of questions (Marks are given in bracket)
Section A	(Objective Type	20 (10)
	(
	(Very short Answer	5 (5)
	type	
Section B	(Essay Type	2(9)
	(Short Answer type	13(26)

Objective type questions may be of the following form:

(I) Completion type (II) True false type (III) Matching type
(IV) Multiple choice type and (V) Identification type.

2. We suggest that distribution of marks to various objectives in Section A, B and in whole paper be according to Table 41.

3. We suggest that multiple choice type question be asked to measure higher order of mental process namely understanding and Application.

4. The nature of the questions should be such as requires the real understanding and knowledge of the subject and not the guess work.

5. We observed that most of the questions were of poor quality as such we suggest for the establishment of question bank.

6. In marking scheme each point or the processess involved in answering the question be written. Present marking scheme is sketchy.

7. The students, although they might have passed in the whole paper, fare very badly in achieving the goals of teaching General Science. Real improvement in standards can come through better teaching in schools and not through doubtful measures of the so-called examination reform. In any case, the movement for examination reform does not seem to have improved the standard of Général Science in our Secondary Schools. For better teaching

in class room, Board can help the teachers by providing good teachers' guide and work book for the students.

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APPENDIX 1

SECONDARY SCHOOL, HIGHER SECONDARY (PART I)
AND HIGHER SECONDARY EXAMINATIONS, 1972

COMPULSORY-GENERAL SCIENCE

TIME : TWO AND A HALF HOURS

Maximum Marks : 50

Roll Number (in figures).....

(in words).....

Day and Date of Examination.....

Name of Examination.....

(Write here Secondary School or Higher Secondary (Part I)
or Higher Secondary at which appearing.)

Section 'A'

Time - 30 Minutes

Maximum Marks-15

1. The planet farthest from the sun is-
(A) Pluto (B) Neptune (C) Venus (D) Jupiter.
() $\frac{1}{2}$
2. The special feature of metamorphic rocks is
that -
(A) They are the oldest.
(B) They are found in layers.
(C) They are formed from other rocks.
(D) They are formed from lava of volcanoes.
() $\frac{1}{2}$
3. In the process of photosynthesis plants take-
(A) Carbon dioxide (B) Nitrogen (C) Oxygen (D) Ammonia
() $\frac{1}{2}$

4. The planet known as morning star is-
 (A) Mars (B) Mercury (C) Jupiter (D) Venus.
 () $\frac{1}{2}$
5. Stalactites and Stalagmites are formed due to-
 (A) Rain water
 (B) Dissolution of calcium carbonate in water.
 (C) Dissolution of calcium carbonate in carbonic acid.
 (D) Dissolution of calcium bicarbonate in carbonic acid.
 () $\frac{1}{2}$
6. Penicillin is obtained from -
 (A) Fungus (B) Algae (C) Bacilli (D) Cocci.
 () $\frac{1}{2}$
7. The main function of vitamin C is to -
 (A) Strengthen the bones (B) Help in reproductive process.
 (C) Help in clotting of blood
 (D) Keep liver healthy.
 () $\frac{1}{2}$
8. The method of improving the breed of mangoes is known as -
 (A) Budding (B) Grafting
 (C) Mass selection (D) None of the above.
 () $\frac{1}{2}$
9. On studying the embryos of fish, hen, rabbit and man we find that -
 (A) Embryos of all these living beings are similar.
 (B) All animals have developed from Aves.
 (C) All animals have developed from pisces.
 (D) Man has originated from fish.
 () $\frac{1}{2}$

10. The acid formed in dental cavities due to bacteria is -

- (A) Hydrochloric acid (B) Sulphuric acid.
(C) Nitric acid. (D) Lactic acid.

() $\frac{1}{2}$

11. An example of the disease caused due to bacteria and virus is -

- (A) Colour-blindness (B) Anaemia
(C) Typhoid (D) Beri-beri

() $\frac{1}{2}$

12. Zinc is used in the preparation of-

- (A) Electric cells (B) Cycle
(C) Railway trains (D) Tools

() $\frac{1}{2}$

13. For cleaning the wounds of skin we should use-

- (A) Bleaching powder (B) Detol (C) Kerosene oil (D) D.D.T.

() $\frac{1}{2}$

14. The main symptom of diphtheria is-

- (A) Inflammation in throat (B) High fever
(C) Loose motions (D) Shivering of body.

() $\frac{1}{2}$

15. On fractional distillation of petroleum, petrol is obtained from -

- (A) 50 C to 70 C (B) 70 C to 90 C
(C) 90 C to 150 C (D) 150 C to 300 C

() $\frac{1}{2}$

16. Top soil is most fertile because-

- (A) It is at the top (B) It receives maximum rain water
(C) It contains more manure (D) It contains humus.

17. Bad conductor of electricity is-

- (A) Copper (B) Silver (C) Zinc (D) Mica.

() $\frac{1}{2}$

18. An example of carbonic manure is-

- (A) Oil cake manure (B) Ammonium Sulphate
(C) Superphosphate (D) Potash Sulphate.

() $\frac{1}{2}$

19. The amount of sleep sufficient for adults is-

- (A) 12 hours (B) 10 hours (C) 9 hours (D) 6 hours.

() $\frac{1}{2}$

20. Aluminium utensils are made of an alloy of-

- (A) Aluminium, Copper and Zinc.
(B) Aluminium, Copper and Magnesium.
(C) Aluminium, Copper and Iron.
(D) Aluminium, Copper and Steel.

() $\frac{1}{2}$

21. Which instrument is used for locating earthquakes ?

..... 1

22. Why does the central core of the Earth shows qualities of a liquid as well as solid ?

..... 1

23. Which process will not occur in plants if they do not get light ?

..... 1

24. Mention any one disease caused due to occupations.

..... 1

25. Why does an atom have an equal number of electrons and protons ?

..... 1

SECONDARY SCHOOL, HIGHER SECONDARY (PART I)
AND HIGHER SECONDARY EXAMINATIONS, 1972

COMPULSORY- GENERAL SCIENCE

TIME : TWO AND A HALF HOURS

Maximum Marks : 50

Section 'B'

Time - 2 Hours

Maximum Marks- 35

1. Explain with the help of a diagram of Fortin's barometer, how atmospheric pressure is measured with it.

{ Description = 3
{ Diagram = 2

Or

Explain, with the help of a diagram, the working of a maximum minimum thermometer.

{ Working = 3
{ Diagram = 2

2. Explain, with the help of a diagram of transmitter and receiver, how do we talk on a telephone.

{ Working = 3
{ Diagram = 2

Or

Explain with the help of a diagram Wireless Communication System.

{ Description = 3
{ Diagram = 2

3. How do we get energy in an atomic reactor? Draw the diagram of chain reaction.

{ Description = 3
{ Diagram = 2

Or

Explain with the help of a diagram the working of an external combustion engine.

{ Description = 3
{ Diagram = 2

4. Mention any two phenomena occurring on the Earth due to the sun. 2
5. How natural caves are formed ? 2
6. Give any four uses of vegetation for human beings. 2
7. If there is a patient of a contagious disease in a house, how can the other members be protected from the disease ? 2
8. How is glass prepared ? 2
9. How does soap clean dirt ? 2
10. What do you understand by polymers ? 1
Give any two of its uses in industry ? 1
11. Mention one similarity and one difference between the formation of coal and petroleum. 2
12. Draw a labelled diagram of a comet. 2
13. Draw a diagram of any one Xerophytic plant. 2

APPENDIX 2

SCORING KEY AND MARKING SCHEME FOR THE EXAMINERS
SECONDARY SCHOOL, HIGHER SECONDARY (PART I)
AND HIGHER SECONDARY EXAMINATIONS, 1972

GENERAL SCIENCE

Scoring Key

Section 'A'

Q.No.	Correct response	Marks
1.	A (B)	$\frac{1}{2}$
2.	C	$\frac{1}{2}$
3.	A	$\frac{1}{2}$
4.	D	$\frac{1}{2}$
5.	C	$\frac{1}{2}$
6.	A	$\frac{1}{2}$
7.	A (B)	$\frac{1}{2}$
8.	B	$\frac{1}{2}$
9.	A	$\frac{1}{2}$
10.	D	$\frac{1}{2}$
11.	C	$\frac{1}{2}$
12.	A	$\frac{1}{2}$
13.	B	$\frac{1}{2}$
14.	A	$\frac{1}{2}$
15.	C	$\frac{1}{2}$
16.	D	$\frac{1}{2}$
17.	D	$\frac{1}{2}$
18.	A	$\frac{1}{2}$
19.	D	$\frac{1}{2}$

Q.No.	Correct response	Marks
20.	B	$\frac{1}{2}$
21.	Seismograph	
22.	Due to high pressure and high temp. $\frac{1}{2}$ mark for each factor written correctly.	1 mark
23.	Photosynthesis	1 mark
24.	Any one of the following diseases mentioned correctly. Anaemia, respiratory diseases, headache, etc.	1 mark
25.	So that it might be electrically neutral	1 mark

Section 'B'

MARKING - SCHEME

- Correct explanation of working of Fortin's Barometer 3 marks
Correct diagram 2 marks

Pages 74-75

Or

- Correct explanation of working 3 marks
Correct diagram 2 marks

Pages 85-86

- Correct explanation of working. 3 marks
Correct diagram 2 marks

Pages 524-525

Or

- Correct explanation of working 3 marks
Correct diagram 2 marks

Pages 534-536

3. Correct explanation of working of nuclear reactor 3 marks
- Diagram of chain reaction, 2 marks
- Pages 386-388
- Or
- Description of working of external combustion Engine. 3 marks
- Diagram 2 marks
- Pages 398-401
4. 1 mark for each correct phenomenon out of the following phenomena
- Day and night, Tides, Seasons. Max. Marks 2
- Pages 16-20
5. Correct explanation 2 marks
6. $\frac{1}{2}$ mark for each correct use out of the following uses : Max. Marks 2
- Food, oils, clothing, medicines, drinks, wood, other useful things.
- Pages 170-172
7. 1. Keep patient in a separate room. $\frac{1}{2}$ mark
2. Allow only attendants to go near him. $\frac{1}{2}$ Mark
3. Vaccination $\frac{1}{2}$ mark
4. Use of disinfectants $\frac{1}{2}$ mark
- Total=2 marks
- Page 272
8. Sodium carbonate, lime stone, glass sand are heated up to 1400 C and the molten mass is used for manufacturing glass. 2 marks
- Page 470
9. See explanation on page 467 2 marks
- Correct explanation.

10. Explanation on page 482 1 mark

Correct explanation. 1 mark

$\frac{1}{2}$ mark for each correct use.

Total=2 marks

Page 482

11. Both are formed due to high temperature and pressure inside the earth. 1 mark

Coal is formed from wood whereas petroleum is formed from sea animals and seaweeds. 1 mark

Total= 2 marks

Page 435

12. Labelling of parts correctly done 1 mark

Diagram correctly drawn. 1 mark

Pages 21-22

13. Diagram drawn correctly. 2 marks

DISTRIBUTION OF THE PERCENTAGE OF MARKS WITH REGARD TO THE OBJECTIVES

PAPER : GENERAL SCIENCE

Q.	SECTION 'A'			Total No. of Question	SECTION 'A' (Other than M.Ch.Q.)			Total No. of Question	SECTION 'B'				
	K	U	A		K	U	A		K	U	A	S	
													S
20	1,3,4,6,7,10,11,12,14,15,18,19	2,5,8,9,13,17,16,20	-	5	21,24	23,25	22	-	13	4,6,3,10	1,2,3,7,11,3,5,9	1,2,3,12,13	
Total													
No. of Marks													
10	6	4	-	5	2	2	1	-	35	3	13	4	10
Perc-entage	60.00%	40%	-	-	40%	40%	20%	-		22.8%	37.2%	11.5%	28.5%

APPENDIX 6

Detailed analysis data and processes involved in answering very short answer type question.

In section A there were 5 questions regarding examinees to write very short answers and each question carrying one mark. Item analysis data of these questions is presented below.

Question No.21

Topic :- The Earth and its mysteries

Objective :- Knowledge

Question : Which instrument is used for locating earthquakes ?

Processes involved :- See Appendix 7

Categories of students	Total No. of each category	No of students writing correct processes			Index of difficulty	Index of discrimination
		1st	Irrelevant answer	Not attempted		
1. First Div. (Higher Group)	42	41	1	-	0.62	0.70
2. Second Div.	62	45	14	3		
3. Third Div.	75	49	23	3		
4. Candidates who failed (Lower Group)	45	13	23	9		

Question No.22:-

Topic :- The Earth and its Mystries

Objective :- Application

Question :- Why does the central core of the Earth shows qualities of a liquid as well as solid?

Processes involved :- See Appendix 7

Categories of students	Total No. in each category	No. of students who could reach to the processess						Index of difficulty	Index of discrimination
		Ist	IIInd	IIIrd	IVth	Irre-leva-nt	Not attempted		
1. First Div. (Higher Group)	42	24	26	22	22	7	1	0.3	0.5
2. Second Div.	62	28	30	23	21	16	2		
3. Third Div.	75	17	18	13	12	24	6		
4. Candidates who failed (Lower Group)	45	5	3	1	1	17	8		

Question No.23:-

Topic :- Plants and A-nimals

Objective :- Understanding

Question :- Which process will not occur in Plants of they do not get light ?

Processess involved :- See Appendix 7

Categories of students	Total No. in each category	No of students who could reach to the processess						Index of difficulty	Index of discrimination
		Ist	IIInd	IIIrd	Irrele-vant answer	Not Attempted			
1. First Div. (Higher Group)	42	41	39	48	1	1			
2. Second Div.	62	54	52	50	2	5	0.75	0.44	
3. Third Div.	75	65	65	56	4	6			
4. Candidates who failed (Lower Group)	45	26	24	24	11	2			

Question No.24

Topic :- Nutrition and Health

Objective :- Knowledge

Question :- Mention any one disease due to occupation

Processess involved :- See Appendix 7

Categories of students	Total No. of each category	No of students writing correct processess			Index of difficulty	Index of discrimination
		Ist	Irrelevant	Not Attempted		
1. First Div. (Higher Group)	42	30	12	-		
2. Second Div.	62	29	33	-		
3. Third Div.	75	28	40	-	0.5	0.46
4. Candidates who failed (Lower Group)	45	12	30	3		

Question No.25

Topic :- Matter and Energy

Objective :- Understanding

Question :- Why does an atom have an equal number
of electron and protons ?

Processess involved :- See Appendix 7

Categories of students	Total No. of each category	No of students who could reach to the processess							Index of Difficulty	Index of Discrimination
		Ist	IIInd	IIIrd	IVth	Vth	Irrelevant Answer	Not Attempted		
1. First Div. (Higher Group)	42	31	28	33	28	24	4	1		
2. Second Div.	62	29	26	30	29	22	15	4		
3. Third Div.	75	19	16	14	11	11	25	7	0.36	0.63
4. Candidates who failed (Lower Group)	45	2	5	2	3	1	15	8		

APPENDIX 7

Processes involved in answering Very Short Answer type questions.

Q.No.	Topic	Objective	Processes involved
21.	Changes inside Earth's surface	Knowledge	Recalls the name of the instrument used in detecting earthquakes i.e. Seismograph.
22.	Interior layers of the Earth	Application	<ol style="list-style-type: none">1. Distinguished the solid and liquid states.2. Recalls the conditions prevailing at the central part of the earth i.e. high pressure and high temperature3. Recalls the effects of high temperature and high pressure on solids and liquids.4. Makes hypothesis that due to high temperature and high pressure the central portion of the earth is in a molten state.
23.	Interdependence of plants and animals	Understanding.	<ol style="list-style-type: none">1. Recalls various processes in the plants and their necessary conditions.2. Distinguish the process in relation to the conditions.3. Locates the process wherein light is required.
24.	Diseases and their prevention	Knowledge	<ol style="list-style-type: none">1. Recalls the name of occupational disease. Such as anemia, shivering of hands and legs, dental disease, respiratory diseases, headache etc.
25.	Structure of Atom	Understanding	<ol style="list-style-type: none">1. Recalls that atom is electrically neutral.2. Recalls the structure of the atom.3. Recognises that the electrons are negatively charged and protons are positively charged.4. Recognises that the quantity of charge on protons is equal to the charge of an electron.

5. Formulates the statement that number of electrons and Protons in an atom is equal to make the atom electrically neutral.

Processes involved in answering short answer type
question of Section B
Question No.4

Topic :- The Universe

Objective : Knowledge

Processes involved:- Recalls the processes and writes any two out of the following:-

1. Obtaining heat and light from the Sun.
2. Formation of day and night.
3. Formation of seasons.
4. Formation of tides.

Question No.5 :- Topic : Innerchanges of the Earth

Objective : Understanding

Processes involved :-

1. Gives reasons carbonic acid is present dissolved in ground water.
2. Flow of this water through the cracks in stones and rocks containing calcium carbonate.
3. Calcium carbonate dissolves in this water, more and more.
4. In thousands of years these cracks take the shape of the caves.

Question No.6 :- Topic :- Plants and Animals

Objective: Knowledge

Process involved :- Recalls the uses out of the following and writes any four:-

1. Food 2. Oil 3. Clothes 4. Medicines
5. Drinks 6. Wood 7. Rubber 8. Paper
9. Colours 10. Gum etc.

Question No.7:-

Topic :- Diseases and their prevention

Processes involved :-

1. Separation
2. Only the attendant goes to the patient,
3. the attendant is kept separately
4. if possible, to send the patient to isolation hospital
5. vaccination
6. use of anti-bacterial substances.

Question No.8 :-

Topic :- Useful Material and its preparation

Objective : Knowledge

Processes involved :-

1. Use of sodium carbonate, lime stone and sand in the preparation of glass.
2. Mixture being heated in the furnace at 1400 C
3. mixture melts in certain period forming molten glass,
4. molten glass is put to moulds
5. to prepare coloured glass, use of cobalt oxide, cuprous oxide, and ferric oxide.

Question No.9:-

Topic :- Useful Material and its preparation

Objective :- Understanding

Processes involved:-

1. Dirt sticks due to oils
2. Molecules of soap dissolves in water
3. Molecules of soap dissolves in oil
4. Suspension of the molecules of soap in water, and oil.
5. around the drops of oil, water drops collect,
6. dirt leaves oil and goes to water drops.

Question No.10:-

Topic :- Useful Material and its preparation

Objective :- Knowledge

Processes involved:-

1. Organic substances such as silk, cotton, rubber, wood etc. having bigger molecular formula, difficult to write as such.
2. bigger molecules contain many smaller molecules linked in thousands
3. Such molecules which are composed of thousands of similar simpler molecules are called ' polymers'.
4. Simplest bigger molecule is ' Polythene!
5. Cites any of the two uses out of the following-
Used in preparation of :
 - i) Clothes
 - ii) threads
 - iii) combs
 - iv) buckets, bottles, tube etc.
 - v) laboratories
 - vi) Plastic glass
 - vii) Plastic bags
 - viii) bakelite for electric pin, switch etc.
 - ix) tyres for cars, airoplane etc.

Question No.11:-

Topic :- Natural Resources

Objective : - Application

Processes involved:-

1. Formation of coal and petroleum at high temperature inside the earth.
2. Formation of coal and petroleum at high pressure
3. Coal is formed by wood
4. Petroleum is formed by sea weeds and animals.

Question No.12:-

Topic :- The Universe

Objective :- Skill

Processes involved:-

1. Draws the diagram correctly
2. Draw the diagram neatly
3. Draw the diagram proportionately
4. Labell the diagram

Question No.13:-

Topic :- Classification of Plants

Objective :- Skill

1. Draws the diagram correctly of any of the following plants:-
(a) Nag phani (b) Babool, (c) Uforbia.
2. Draws the diagram neatly
3. Draws the diagram proportionately
4. Labels the diagram.

APPENDIX 3

Processes involved in answering Essay Type Question

Q.No.1 (either)

Topic :- Atmosphere

Objective :- Skill and Understanding

Processes involved:-

1. Draws correct diagram of Fortin's barometer.
2. Draws neat diagram of Fortin's Barometer.
3. Draws proportionate diagram of Fortin's Barometer.
4. Labels the diagram.
5. Explains working- touching mercury level to pointed end of the pointer with the help of screw,
6. adjusting vernier scale to the upper level of mercury column,
7. reading the height of mercury column by the help of vernier scale,
8. adding the main scale reading to vernier reading to get height of mercury column,
9. explains the atmospheric pressure in terms of height of mercury column.

Question No.1 (Or)

Topic :- Atmosphere

Objective :- Skill & Understanding.

Processes involved:-

1. Draws the correct diagram of Maximum Minimum Thermometer.
2. Draws the neat diagram of Maximum Minimum Thermometer.
3. Draws the proportionate diagram of Maximum Minimum Thermometer.
4. Labels the diagram of Maximum Minimum Thermometer.
5. Explains the working of Maximum Minimum Thermometer, touching the index to the mercury column with the help of magnet.
6. On increase of temperature alcohol the Bulb 'A' expands and presses mercury level downward.

7. Corresponding mercury rises upward in the otherside 'B' and index thrown upward,
8. On decrease of temperature alcohol shrinks in 'B' and its mercury level goes upward,
9. reads max. temperature with the help of index in tube 'A',
10. reads minimum temperature with the help of index in tube 'B'.

Question No.2 (Either)

Topic :- Communication

Objective :- Skill and Understanding

Processes involved:-

1. Draws correct diagram 2. Draws neat diagram
3. Draws proportionate diagram 4. Labels the diagram
5. speech causing sound waves falls on diaphragm and vibrates it.
6. carbon particles comes in motion 7. change in resistance of the electric circuit. 8. increase and decrease in the strength of current 9. conversion of sound energy to electrical energy - sound currents 10. sound currents converts to sound energy in the receiver 11. flow of sound currents in the magnetic coils. 12. similar change of of increase and decrease in magnetic power, 13. attraction in diaphragm. 14. vibrations in diaphragm 15. formation of sound energy again.

Question No.2(Or):-

Topic :- Communication

Objective :- Skill and Understanding.

Processes involved:-

1. Draws correct diagram 2. Draws neat diagram
3. Draws proportionate diagram 4. labels the diagram
5. speaking in microphones in the broadcasting centre,
6. conversion of sound waves into electrical waves,

8. formation of modulated waves, 9. extending these modulated waves 10. sending these waves in Antina,
11. transmission of these waves from Antina. 12. passing of these waves through aerial and producing feeble waves therein, 13. extending feeble waves 14. separating modulated waves, 15. extending modulated waves, 16. extended modulated waves sent to loud speaker 17. conversion of modulated waves in sound waves, 18. hearing, the same sound through receiver as broad casted.

Question No.3 (either)

Topic :- Atomic Energy

Objective :- Skill and understanding

Processes involved:-

1. Draws correct diagram of chain reaction.
2. draws neat diagram of chain reaction
3. draws proportionate diagram of chain reaction
4. Labels the diagram of chain reaction .
5. explains the bombardment of neutrons on heavier atoms like Uranium.
6. conversion of Uranium to Strontium and Barium
7. Loss of mass in this conversion causes formation of energy.
8. Simultaneous formation of 2-3 free neutron.
9. Dis-integration of other atoms by these free neutrons.
10. again formation of energy, lighter atoms and then again free neutrons.
11. every moment disintegration process goes on i.e. chain reaction establishes.
12. controlling the number of free neutrons and thereby preparing atomic energy in a desired way.
13. the whole unit-where in the chain reaction takes place and energy is produced is called Atomic Reactor.

Question No.3 (or):-

Topic :- Uses of Energy

Objective :- Skill and Understanding.

Processes involved:-

1. Draws diagram correctly for External combustion Engine.
2. Draws diagram neatly for External Combustion Engine.
3. Draws diagram proportionately for External Combustion Engine.
4. Labels diagram for External Combustion Engine.
5. Burning fuel in boilers and converting water into steam,
6. Steam from boiler to steamchamber is brought and pressure increased,
7. Steam goes to cylinder via slide valve from the steam chamber
8. Movement of slide valve onward and backward in such a way that only one way is open at a time,
9. movement of steam from left to the right, side in the cylinder and thus pressing piston,
10. movement of piston rod and contact rod from left to right.
11. motion in fly wheel, due to piston rod and contact rod movement,
12. central rod attached to wheel and its relation with slide valve,
13. movement of piston rod, causes central rod and slide valve, a motion from left to right,
14. causing the close of steam entering in the cylinder in the former path,
15. steam enters from the other side into the cylinder,
16. accordingly piston is forced to move
17. movement of piston rod from right to left,
18. extra steam of the cylinder comes out through valve,
19. piston rod, contact rod moves onward and backward, causing circular motion in the fly wheel,
20. piston and cylinder, since linked to fly-wheel causes continuous alternate entry of steam and push to the piston.
21. fly wheel causes the motion to the wheels of the engine.

APPENDIX 9

Date. F-15/68
12.7.83

Item analysis data for essay type question No.3

Topic :- Matter and Energy

Objective : Understanding (3 marks), Skill (2 marks)

Question :- How do we get energy in an atomic reactor ? Draw the diagram of chain reaction.

Processess involved : See Appendix 8

Categories of students	No of students in each category	Response in terms of processess												
		1	2	3	4	5	6	7	8	9	10	11	12	13
1. First Div.	17	16	9	11	14	15	9	3	3	10	5	7	3	4
2. Second Div.	19	11	5	2	4	10	5	1	5	3	4	4	-	2
3. Third Div.	19	8	5	2	6	7	5	5	1	-	-	1	-	-
4. Candidates who failed in the whole paper.	5	2	1	1	-	-	-	-	-	-	-	-	-	-

Question No.3 or

Topic :- Matter and Energy

Objective : Understanding (3 marks), Skill (2 marks)

Question : Explain with the help of a diagram the working of an external combustion engine.

Processess involved : See Appendix 8

Categories of students	No of students in each category	Response in terms of processess																	
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1. First Div.	25	17	10	14	12	12	13	8	10	12	10	10	9	13	14	5	7	6	2
2. Second Div.	43	16	13	5	9	16	17	10	10	12	11	8	4	6	6	5	9	7	2
3. Third Div.	56	15	8	6	8	29	16	11	7	12	11	7	5	1	4	5	7	5	3
4. Candidates who failed in whole paper	40	5	3	3	3	5	2	-	-	-	2	-	-	-	-	2	2	-	-